

# No Photos Harmed / Growing Paths from Seed – An Exhibition

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Figure 1: *The Dancing Salesman Problem - original sketch.*

## Abstract

We report on an exhibition centered around a dialogue between a Computational Creativity researcher presenting artwork generated by a computer program and a classically trained artist taking inspiration from the computational processes. The main purpose of the exhibition was to place software-generated art (where the program takes on some aesthetic and generative responsibilities, rather than acting as a mere tool) in both an art-production context and an art-historical context, by exploring the themes of *creative responsibility* and the *loss of aura* surrounding a work of art. A secondary purpose was to highlight the fact that computer generated art can be representational without relying on digital photographs as inputs. We describe certain technical hurdles we overcame in the production of the exhibition and the feedback we gained, in addition to elaborating on how the event and the project as a whole fits into an art-historical context. We conclude with brief details of another exhibition involving art generated by the same software system, where the notion of *progression* was explored; by describing a planned exhibition, where *autonomy* and *independence* in the system will be highlighted; and by providing a partial roadmap for progress towards autonomously creative software in the visual arts.

**CR Categories:** I.3.2 [Computer Graphics]: Graphics Systems—Stand-alone Systems

**Keywords:** Computational Creativity, Art Exhibitions, History of Art, Computer Generated Art

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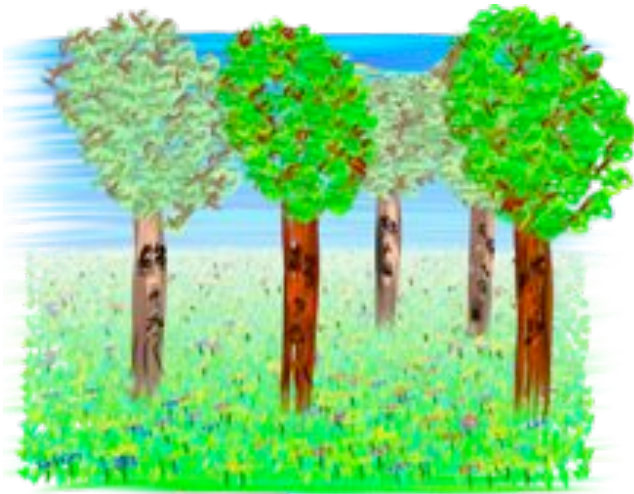
## 1 Introduction

The Painting Fool ([www.thepaintingfool.com](http://www.thepaintingfool.com)) is a computer program that we hope will one day be taken seriously as a creative artist in its own right. This is an earnest endeavour of the type against which careers can be weighed. Success here will require both technical innovations and some societal changes in the opinions of people with respect to the creativity (or lack thereof) in software. As such, the project falls squarely within the field of Computational Creativity [Colton et al. 2009] [Cardoso et al. 2009], where researchers study how to build software that can take on some of the creative responsibilities in arts and science projects.

With respect to the graphics techniques underpinning The Painting Fool, we have implemented some standard non-photorealistic rendering algorithms, along the lines of some of those described in [Strothotte and Schlechtweg 2002]. These include image segmentation, curve fitting, 3D modelling, colour mapping, and the simulation of natural media including paints, pastels, pencils, watercolours, charcoal sticks, palette knives and brushes, and their usage for outlining and filling regions on simulated papers and canvases. A detailed discussion of the baseline graphics features of the software is given in [Colton et al. 2008] and [Colton 2012b].

We have also worked with some machine vision techniques, including face detection and in particular emotion detection, which drove an empathic painting project described in [Colton et al. 2008], of a similar nature to that described in [Shugrina et al. 2006]. We have also given the software the ability to appeal to simple aesthetic criteria such as colour distribution, symmetry and contrast in the assessment of the images it produces [Colton 2012a], in addition to more sophisticated evaluation criteria, such as those described in [den Heijer and Eiben 2010] and [Ekárt et al. 2011].

Finally, to move away from a dependency on photographic inputs, we have worked with various Artificial Intelligence techniques to enable The Painting Fool to generate scenes from a perceived imagination. These techniques include concept formation [Colton 2008a], evolutionary approaches [Colton and Torres 2009] [Colton et al. 2011] [Colton 2012a], constraint solving [Colton 2008c] and multimedia retrieval [Krzeczkowska et al. 2010] [Cook and Colton 2011] [Colton et al. 2012], and can be harnessed via a layering approach to scene generation, described in [Colton 2010] and [Colton 2012b]. We have recently enabled The Painting Fool to produce sculptures, animations, 3D galleries and poetry, as described in



**Figure 2:** An example image from the *PresidENTS* series, with the title of the series emphasising the tree people of Tolkein’s *Lord of the Rings* book cycle (*Ents*), depicted using the images of American presidents – in this case, Barack Obama.

[Colton 2011]. Of particular relevance here, we have also enabled the software to work with the *Context Free* program (available at [www.contextfreeart.org](http://www.contextfreeart.org)) which uses Context Free Grammars to generate abstract artworks and objects such as trees and figures very efficiently from user-supplied grammars.

As an illustration of the kind of image The Painting Fool can generate, an example from the *PresidENTS* series of images is given in figure 2. The size, placement and saturation of the trees, grass and flowers were decided by generating solutions to a constraint satisfaction problem abduced by the system from the user dragging rectangles around [Colton 2008c]. The images of faces were given by the user, then segmented and abstracted. The trees were generated by the software varying and layering hand-drawn templates of trees, trunks, leaves and twigs. The scene was rendered using a simulation of acrylic paints with a heavy tapering style.

With respect to the cultural aspects of the project, we have endeavoured to promote to audiences the idea of software being independently creative. The project has always been driven forward by well meaning criticisms from people who disagree with using the word “creative” to describe the software, as described in [Colton 2008b] and [Colton 2012b]. For this reason, we have been active in gaining feedback from artists, art critics, art historians, art educators and students, in addition to the general public via talks and demonstrations, the presentation of technical papers, interviews with journalists, and through the maintenance of a website. We have also been part of five group exhibitions, where we have tried to (a) emphasise higher level considerations related to the building of autonomously creative software and (b) place the project in various cultural and art-historical contexts, through the presentation of artworks and the demonstration of new pieces being produced live.

In the next section, we describe an exhibition from March 2011 entitled *No Photos Harmed / Growing Paths from Seed*, by giving details of our motivations, new software written specifically for the exhibition, and outcomes of the exhibition. We take the opportunity in section 3 to elaborate on the art-historical contexts within which we placed the exhibition originally, via a discussion relating to creative responsibility in the history of art, and the loss of aura associated with modern developments. We conclude by describing another previous exhibition whereby a timeline of the development



**Figure 4:** An autumnal example from the *Four Seasons* piece.

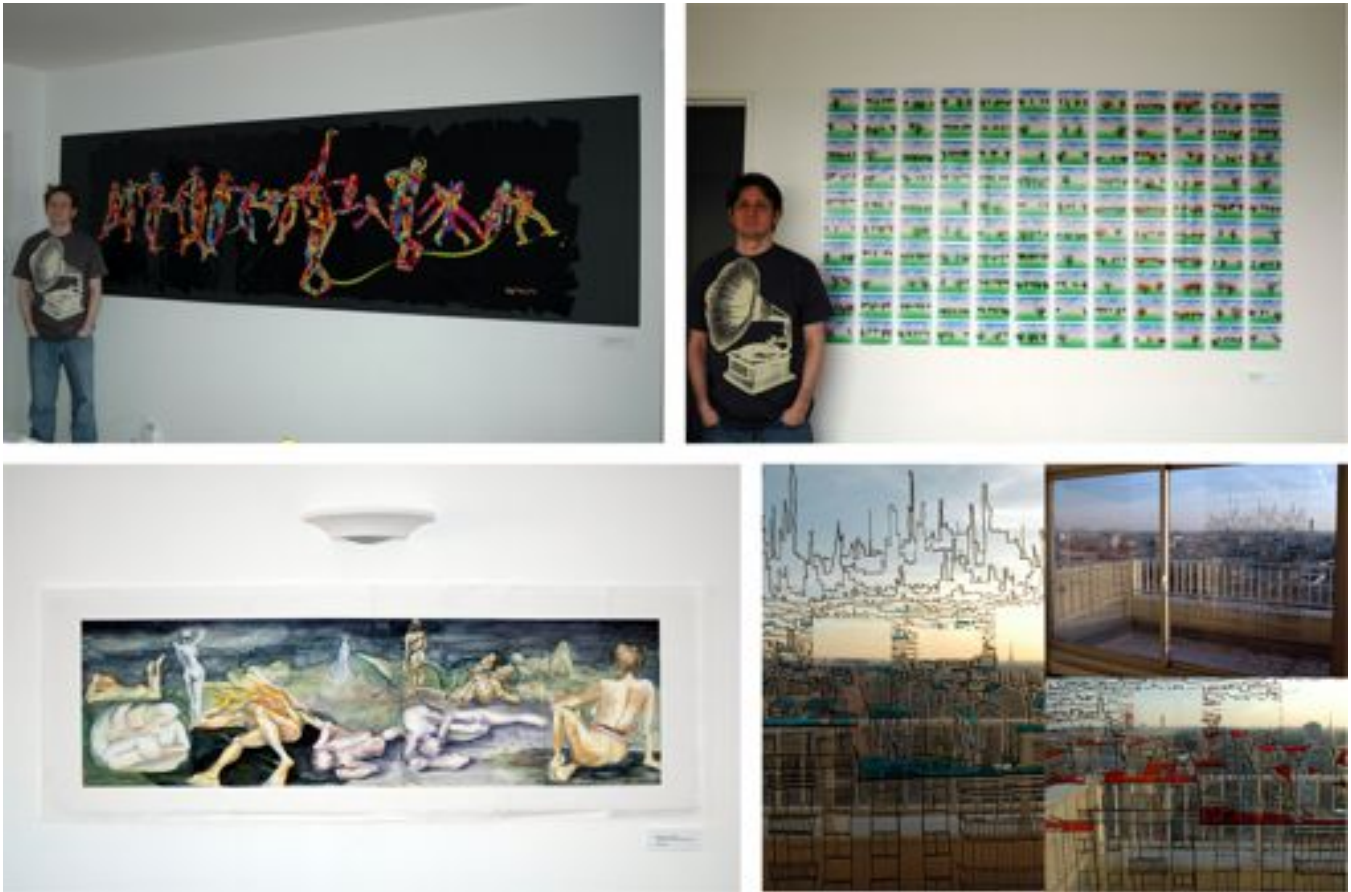
of The Painting Fool was given in order to highlight how software progresses and becomes more skilful, appreciative and imaginative as time passes and the implementation grows. We also describe a forthcoming exhibition where the theme of autonomy and independence in software will be emphasised. We put this into the context of a series of planned technical and cultural advancements we have planned on the way to realising the goal of building an autonomously creative artist.

## 2 Exhibition Details

The *No Photos Harmed / Growing Paths from Seed* exhibition was held over a period of two weeks from 19th March to 3rd April 2011. It was held in a private gallery in Paris and had three viewings: a vernissage on 19th March, attended by more than 100 people; a midstage on 24th March, attended by 10 people; and a finisage on 3rd April, attended by around 60 people. The exhibition was presented as a dialogue between a scientist (Computational Creativity researcher and first author on the paper: Simon Colton) and artist Eileen Chen (classically trained and currently employed as an architect). In addition to the process panels described below, the exhibition contained four pieces, two from the researcher, who worked with The Painting Fool to produce them, and two from the artist. The pieces are portrayed in figure 3.

The first piece from The Painting Fool is entitled *The Dancing Salesman Problem* and is 3m by 1m in dimension. It consists of 317 photograph sized printouts (15cm by 10cm), each produced at a resolution of greater than 500dpi, placed at random angles overlapping each other to cover the whole board. It depicts 17 figures in various poses, and is rendered with simulated acrylic inks in various energetic colours, with a fluid painting style that includes strokes connecting figures which are quite far apart on the canvas. The second piece from The Painting Fool is entitled *Four Seasons* and is 2m by 1m in diameter. It consists of 120 photograph sized printouts (15cm by 10cm), each produced at a resolution of greater than 600dpi, placed in a grid. Each of these sub-images depicts a countryside scene containing clouds, grass, sky and trees. An example of one of the sub-images is given in figure 4. There are twelve columns representing the months of the year, and the weather conditions for each of the months are represented in the changing states of the trees. Details of how the two pieces were produced are given in subsection 2.2 below.

The first piece from the artist is entitled *Generation of 13 Nudes* and was produced in watercolours, on paper mounted on board. It is 1.5m by 80cm in dimension. It depicts 13 nude figures, with



**Figure 3:** Artworks exhibited: top two by *The Painting Fool* (*The Dancing Salesman Problem* and *Four Seasons*), bottom two by the classically trained artist (*Generation of 13 Nudes* and *LeGrandParis.xml*).

the state and pose of each influenced by Anne Carson’s Poem “The Glass Essay” [Carson 1995]. The second piece from the artist is entitled *LeGrandParis.xml* and was produced using permanent marker on transparent film which was then overlaid onto the windows of the gallery so that some of the buildings in the piece overlapped with the real buildings in the Paris suburban scene, but were extended in places in a futuristic style. Moreover, blank areas were left in the piece, so that – when viewed from the correct position, height and angle – various real Parisian landmarks such as the Eiffel Tower were framed by the blank areas as postcards.

In addition to the four pieces, for the viewings, a projector was set up to show *The Painting Fool* producing examples from *The Dancing Salesman Problem* series. In particular, each simulated stroke is given as a fluid movement, and each stroke leads onto the next. Videos of the painting process are available at [www.thepaintingfool.com](http://www.thepaintingfool.com), and a photograph of the demonstration projected during the exhibition viewings is given in figure 5.

## 2.1 Dialogues

The main motivation behind the exhibition was to frame *The Painting Fool* project within various artistic contexts, in order to enable the audience to form an educated view about the potential for autonomously creative software in the visual arts.

To put *The Painting Fool* and its exhibition works into an art production context, the dialogue between the artist and the scientist

centred around the ways in which the two art-generation processes could be compared, and the ways in which the artist could take motivation from the computational processes. To portray this dialogue, in the two rooms of the exhibition space, a work from the artist was placed opposite that of the scientist in order to enable visual comparisons, with *Generation of 13 Nudes* opposite *The Dancing Salesman Problem* and *LeGrandParis.xml* opposite *Four Seasons*. In addition, a set of 11 process panels were produced and displayed, with one shared process panel and 5 each depicting the production of *The Dancing Salesman Problem* and *Generation of 13 Nudes*. Each panel has a pictorial representation of an aspect of the production process, and a few sentences of explanation.

The first panel describes how the artist took motivation from viewing XML code, which is at the heart of how *The Painting Fool* records aspects of its process (style files for rendering, colour palettes, etc.) and aspects of its output (for instance, segmentation files as vector graphics). The XML code from a particular file was eventually used as the basis for the futuristic skyscrapers in the *LeGrandParis.xml* piece, which further emphasised the link between the two sets of work. Moreover, the title of the artist’s half of the exhibition, namely *Growing Paths from Seed* was chosen to emphasise how the seed of the XML code influenced the production of her artworks. The text in the 10 panels following the shared one was carefully chosen to emphasise as much as possible the links between the two processes. These include (a) subject material – in both *The Dancing Salesman Problem* and *Generation of 13 Nudes*, the pieces are figurative (b) colour palettes which were



**Figure 5:** Photograph of the projected live demonstration.

shared between the two pieces, and (c) external motivations, namely the Travelling Salesman Problem from Computer Science, and the poem by Anne Carson. A photograph of the process panels and the texts from them are given in the appendix.

The title of the scientist’s half of the exhibition, namely *No Photos Harmed* was chosen to emphasise the relationship of The Painting Fool with other software-based art production methods. In particular, there are two popular conceptions of what generative art can produce: firstly, starting from photographs, pastiches in the style of various artists (and more novel styles) can be produced using software such as Adobe Photoshop; secondly, via methods such as fractal calculations and evolutionary art, abstract and beautiful pieces can be produced. By stating that “No Photos Were Harmed in the Production of These Pieces” (the full title), we emphasised that, while they are clearly representational (figurative pieces and landscapes), digital photographs were not used as base art materials. This highlights a third type of generative art, which is representational but not based on photographs. This point was further ironically emphasised with the production method for both of The Painting Fool’s pieces, i.e., where photograph-sized printouts, normally associated with photography, were used as the physical basis of the two pieces.

To put The Painting Fool and its works into an art-historical context, the dialogue centred around the ways in which creative responsibility is willfully handed over in the arts. This is clear in the case of The Painting Fool, where the software is asked to produce entire pieces, and the modus operandus is to never tamper with the final product, i.e., if the pieces are not ready for some reason, then we either write better generative or better analytical software and run the software again, rather than fixing the pieces by hand. To appeal to this context, the artist chose the medium of watercolour for Generation of 13 Nudes, which can lead to loss of fine-grained control, and she highlighted the handing over of creative responsibility in the process panels. In addition, with the LeGrandParis.xml piece, the artist was forced to cede some creative responsibility to the architects and town planners of the city of Paris, as this formed the basis for the content in the piece.

In later discussions with an art historian (second author of this paper), the art-historical context of handing over creative responsibility has been expanded in section 3, and this is extended by framing The Painting Fool in the context of *loss of aura* in the age of mechanical reproduction and the age of computational processes.

## 2.2 Producing the Software-Generated Pieces

The scene in each of the individual sub-images in the Four Seasons piece was produced via a template into which layers of grass, sky, clouds and trees were generated and placed. The position of these elements was decided by moderate variation of the template locations for the sky and clouds; random positioning of the grasses; and the solving of a constraint satisfaction problem (CSP) as per [Colton 2008c] for the placement of the trees. In addition to ensuring that the trees were scaled to be in perspective, the CSP solution specified the overall saturation level of each tree, so that smaller (further away) ones were less saturated, giving a look of distance. The individual trees and clouds were generated with a context-free design grammar (both of which were downloaded from [www.contextfreeart.org](http://www.contextfreeart.org)). The grasses were from a template which was varied, and the segmentations of the scene layers were rendered with simulated pencil and pastel strokes. For each of the 12 months, 20 images were produced, and 10 were chosen for the final piece.

The figures in The Dancing Salesman Problem piece were generated from two context-free design grammars (again downloaded from [www.contextfreeart.org](http://www.contextfreeart.org)) which can generate male and female mannequins. The piece takes its name from the novel painting style we implemented that enables the software to essentially paint an entire scene in one stroke. While the stroke changes colours and peters out and back in again, each stroke leads onto the next. To enable this, before the rendering of a segmentation (the basis of how The Painting Fool produces its pieces), the segmentation is transformed into a series of lines with one starting where the previous one ends. Each line constitutes the boundary of a segment, and is extended in order to meet the next line at the half-way point between the two. To cover all of the segments in the segmentation, we posed this as an instance of the Travelling Salesman Problem, whereby a salesman has to drive to each of a set of towns, without returning to any of them. By mapping each segment onto a town, and implementing the simplest solving method for these problems (which is to travel to the nearest town that hasn’t been visited before), we implemented the new painting style. We were intending to write more sophisticated solving methods, but we found that the corrections where the next unvisited town is a long way off leads to long paint strokes which add vibrancy and unpredictability to paintings, hence we have so far kept the simple solving method.

We chose to produce The Painting Fool’s pieces to a high professional standard in terms of image resolution. In particular, The Dancing Salesman Problem image was produced at 80,000 by 12,000 pixels, hence it consists of nearly a billion pixels (albeit many of which are black). This size was calculated so that when printed onto a 3m by 1m canvas, the print resolution would be over 500dpi, which means that even at millimetre distances, it is not possible to see pixelation. When printed onto glossy photographic paper at this resolution, the bright colours in the piece are particularly vibrant. To cope with the memory issues associated with producing a piece of this size, we implemented standard tiling methods, whereby the software only works on a single tile at any time, keeping the tiles on the hard drive, and saving/loading them when required. With 16Gb of memory available, we found that only 10 tiles were required for the billion-pixel images. To cope with efficiency issues, we also implemented a multi-threading approach whereby sequences of non-overlapping paint strokes are metered out to individual cores on a multi-core machine for increased speed. However, the tiling method interfered with this, as non-overlapping paint strokes were often on different tiles. In future, we will implement more sophisticated parallel-processing routines.

As we wanted curatorial control over the piece eventually printed and exhibited, we chose to produce around 100 sketches (at 8,000 by 1,200 pixels), rather than multiple billion-pixel images, because

these take around 17 hours to produce on a 24-core Mac OS X machine with 16Gb of RAM. In order to generate the full size image from the chosen sketch (which is portrayed in figure 1), we implemented the ability for The Painting Fool to record the sketch paintings as vector graphics, i.e., sets of paint strokes in XML code, and for it to re-paint the piece with larger brush sizes. The brush sizes for the sketches were in the order of 50 pixels wide, while the final brush sizes were in the order of 500 pixels wide.

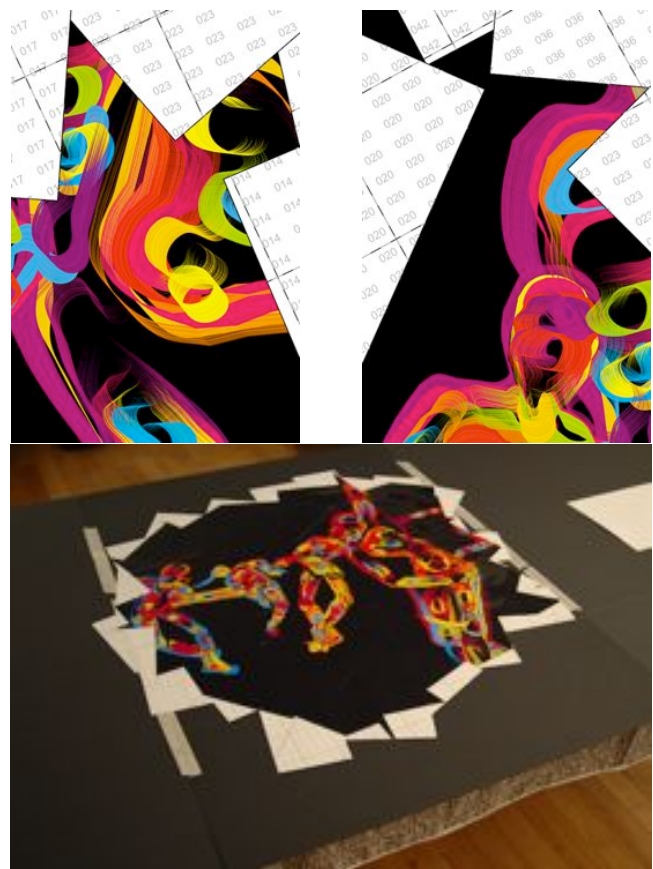
To produce the final piece for the exhibition, we implemented a routine which was able to take the tiled image and extract a set of overlapping, randomly rotated sub-images which would print onto borderless 10cm by 15cm photographic papers. This was done in such a way that the overlap was sufficient to avoid holes showing through. Starting from the centre and working outwards, we had a number of abortive attempts to produce the piece, as it was very difficult to line up the sub-image printouts. To combat this, we experimented with getting the software to print various guidelines onto the non-showing parts of the printouts, until we found one we could work with. Examples of the photo-sized printouts with the guidelines on, and a depiction of the construction process are given in figure 6. The printouts were glued onto four pieces of 1m by 80cm black foam board, taking around 24 hours of effort.

### 2.3 Feedback

The viewings for this exhibition were carried out in the long tradition of evenings where no surveys are undertaken, and only informal feedback is sought. Given the profession of the (amateur) artist as an architect, many of the invited guests were young architects. The use of generative techniques in architecture is very much a hot-topic at the moment, and so these audience members were particularly intrigued by the *No Photos Harmed* theme and the potential for context-free grammars in generative art applications. They were particularly pleased to hear that the usage of such grammars in graphics was originally motivated by architecture applications [Stiny and Gips 1971].

In general, it was interesting to note the general acceptance of the value of generative art. In particular, we found that the demonstration of The Painting Fool in action (see figure 5) was very much appreciated by many audience members, who used words like “mesmerising” to convey how they felt about seeing pieces produced live. This led to a number of people asking for quantification of the amount of creativity exhibited by The Painting Fool in the production of these pieces. After some thought, wherein the level of creative input, the quantity of decisions made, and the level of surprise produced by the software were weighed, a split of 90/10% of creative responsibility in favour of the researcher using the software was chosen. While somewhat arbitrary, this was accepted largely without argument, which we found interesting, as it may justify the usage of such estimates in future. As discussed in section 4 below, we have already begun to increase the 10% figure with new implementations and applications, and we plan to continue doing this.

There were many positive comments about the level of professionalism in the exhibition in general, and about the high-resolution images in particular. Some people were particularly impressed by the simulation of rendered paints, and were initially confused that they weren’t actual paint strokes – until encouraged to have a closer look. Other people were impressed by the software choosing the colour, position and nature of each paint stroke, i.e., they could imagine themselves using Adobe Illustrator to produce something similar, but couldn’t imagine a program doing this automatically. It was somewhat disappointing not to get much negative feedback about why it is (or will always be) inappropriate to talk about software being creative – gaining such feedback is a default aim of such outreach projects, as this fuels further research. This was possibly due



**Figure 6:** *Top: two examples of photograph-sized printouts at 500dpi for The Dancing Salesman Problem piece. Bottom: snapshot during the construction of the piece.*

to the politeness of the audience members, and possibly because we had done our job well, and enabled people to take an informed view of the potential of software in the arts.

The Dancing Salesman Problem and Four Seasons pieces have had an additional life after the exhibition. In particular, the former appeared in a double-page spread of an article on Computational Creativity in The New Scientist popular science magazine [de Lange 2012], with parts of the latter also portrayed. This led to a follow up piece in the online io9 magazine, with amusing reader comments, largely relating to the Terminator series of films [Wilkins 2012]. The Observer newspaper also featured The Painting Fool and The Dancing Salesman Problem in two pieces on Artificial Intelligence [Kappala-Ramsamy 2012] [du Sautoy 2012]. Moreover, The Dancing Salesman Problem piece was featured in a BBC Horizon documentary on Artificial Intelligence, which marked the 100th anniversary of Alan Turing’s birth. During the filming of the documentary, images produced by The Painting Fool were shown to artists and gallery owners in Paris, who were asked for their responses before and after being told that the pieces were generated by software. In an interesting honest response from one gallery owner, before being told that The Dancing Salesman Problem was produced by software, he said that he was very interested in the piece, and could imagine selling it. After being told about The Painting Fool, the gallery owner said that he liked the piece even more, but said that he would have a more difficult time selling it to his customers due to the nature of its production. The BBC documentary led to sales of prints of The Dancing Salesman Problem to members of the public, which marks an important milestone in The Painting Fool project.

### 3 Contexts in the History of Art

In addition to raising awareness of the potential of software to produce pieces of real cultural value, exhibitions are very useful milestones where one can take stock and consider the project in various contexts. As mentioned above, one of our motivations with the *No Photos Harmed / Growing Paths from Seed* exhibition was to enable a dialogue between a Computational Creativity researcher and a classically trained artist. One of the outcomes was the emergence of the theme of *handing over creative responsibility*, in both computer generated art and in traditional art practice, which we expand upon here, followed by a discussion of *loss of aura* in the arts.

#### 3.1 Creative Responsibility

There are various popular conceptions of painters at work, for instance the starving artist working in a garret, producing great art to sell in order to pay the rent. Another popular image which requires some scrutiny is the artist as the entire creative force behind the production of their art. This specific idea of artist has only existed since the 19th century, having evolved since Renaissance times, when artists began framing their work in more intellectual contexts, in order to improve their position in society. In many cases, this artist-centric impression is true: the artist conceives an overall idea for a painting, then assembles the art materials, places every stroke on the canvas, possibly gives the piece a title and might also write essays about the piece. It is clear to see why this conception of the artist is popular, as it emphasises the creativity of an individual, and as a society, we very much value creative people.

However, throughout the history of art, artists have often ceded some of the responsibility behind art production to other people. This may have been against their will, with a client imposing unwelcome constraints on a commission, or it may have been for practical considerations of time and/or effort and/or practicality, whereby an artist has worked with apprentices in an atelier, or hired a craftsman to undertake artistic processes under their guidance. Alternatively, it might have been for educational purposes, whereby an apprentice is given a task to undertake on a larger painting, or even to produce an entire painting from a drawing made by the master. As an extreme example, according to [Vasari 1998], in the production of *The Baptism of Christ* (1472-1475), the master Andrea di Cione, known as Verrochio, collaborated with his apprentice, Leonardo da Vinci – with the latter being responsible for painting two angels in the scene. Vasari reports that Da Vinci's work was judged by Verrochio as so superior to his own, that Verrochio chose never to paint again. More contemporary examples include Damien Hirst and Takashi Murakami, who employ workshops of artists, with Hirst reputed to have a “150-strong team of assistants” in [O'Hagan 2012].

In addition, some artists willfully cede some *creative responsibility* to another person, people in a collective, a technique, a medium, and in modern times: a computer program. By ‘creative responsibility’, we use a fairly inclusive definition to mean that aspects of a whole artwork are produced by an agent which is not completely controlled by the artist. This is done in such a way that the resulting work may surprise, educate and inform the artist, either at the level of an individual artwork, the level of a style or an aesthetic consideration, or at a conceptual level. The agent in question here could naturally be another person or group of people. This could be an apprentice or workshop employee, as above, where the feedback is expected to be at least a little surprising, i.e., where the subordinate is given more creative license. Alternatively, the collaboration could be more egalitarian and direct, and an important part of the creative process. As a famous example of this, Jean Tinguely and Niki de Saint Phalle worked together on the *Stravinsky Fountain* (1983) at the Centre Pompidou in Paris. Here, the roles of the

artists were largely separate – with Tinguely working mostly on the kinetic mechanisms and de Saint Phalle working mostly on the colourful exterior of the fountain. A more recent and immediate example where artists have simultaneously worked on the same canvas, is the work of naturalist painting duo Williams and Winstanley, who paint *hand over hand* [Williams and Winstanley 2003].

Mutual creative influence can also be seen with artists working in larger collectives, whereby ideas and techniques are swapped and extended, such as in the European CoBrA collective (1948 - 1951), [Dempsey 2010] (page 193) in which some paintings are attributed joint authorship, such as the work *Je lève, tu lèves, nous rêvons* (1948) by Christian Dotremont and Asger Jorn. In particular, the series of paintings known as *Peintures-Mot*, where words and images were combined, were all produced in collaboration. As the influence raises to the level of that of a movement, whereby artists work within a genre, or to a certain set of ideals, such as with the Futurists, Cubists or Impressionists, etc., artists exchange ideas and techniques. However, it is difficult here to say that one artist is ceding creative responsibility to others.

When the agent to whom an artist cedes creative responsibility is another person, there is the implicit assumption that a conscious, salient and communicable thought process has gone into the execution of that responsibility. In contrast, however, the agent may be as simple as a technique within which a medium or a tool is not completely controlled by the artist. For instance, certain media allow the artist less fine-grained control over the way pigments are placed on a canvas or paper, e.g., with watercolours, the artist has to literally go with the flow sometimes. Jackson Pollock exemplified how to productively use levels of randomness with art materials, as the artist ceded creative responsibility (to a small extent) to the effects of gravity on paint dripping from a brush or can. Naturally, Pollock explicitly developed this method, thus he exerted high level control while handing over low level control. As another example, the British twentieth century artist Francis Bacon was well known for making wild stabbing movements at the canvas, with the lack of control often leading to unexpected results which could be opportunistically turned to his advantage. Farson indicates that:

With the confidence he gained, his approach became even more dangerous, and as a result, more vibrant. In the fifties he often talked about working as close to instinct or as close to his nervous system as he could. He was fascinated to see how the paint fell, turning this to his advantage... [Bacon said that] ‘...out of this chaos comes the possibility of making an image I hadn't thought of before’. [Farson 1994] (page 83)

Seen in the context of handing over creative responsibility, it is clear that at the time of the *No Photos Harmed / Growing Paths from Seed* exhibition, *The Painting Fool* was an agent that an artist could willfully cede creative responsibility to, but which exists between the extremes of mere tool, medium or technique from which semi-random stylistic feedback can be gained (Bacon's stabbing movements, Pollock's dripping method) and a sentient creative collaborator (Hirst's workshop ateliers), where intelligent choices are made in order to handle the responsibility given in the art production process. Working with *The Painting Fool* to create *The Dancing Salesman Problem* and the *Four Seasons* pieces involved expressing ideas to the software, waiting for it to construct a painting and then either producing more of the same prototype – to see if a particularly good exemplar of the genre could be produced – or moving on to a new prototype. For instance, with *The Dancing Salesman Problem* piece, many examples of around a dozen prototypes were produced before the final artwork was selected for the exhibition and then re-rendered to be of sufficient resolution quality. Two examples of rejected prototypes are given in figure 7.



**Figure 7:** Examples of prototypes preceding the final production of *The Dancing Salesman Problem* piece.

Given this collaborative working approach, we see that particular styles and techniques and the simulation of the usage of particular art materials can be experimented with. However, it is difficult to describe The Painting Fool as taking on creative responsibility only in the same way as a random stab of a paint brush might, as the software constructs, places and simulates the painting of figures. In many respects, the software acts like a subordinate artist when working collaboratively. However, the version of The Painting Fool used in the exhibition had no critical ability and didn't appeal to any aesthetic considerations, i.e., it was merely generative. It therefore is not correct to elevate the software to the level of human workshop employee or similar, and the software fits naturally between the extreme of tool and collaborator.

Of course, other pieces of art enabling software, such as Adobe's Illustrator package, also fit naturally between these extremes. However, The Painting Fool's generative abilities distinguish it from the level of tools such as Illustrator, as the software is able to create complex scenes before rendering them, with the scenes often constructed using AI techniques such as context free grammars and constraint solving (in the case of the Four Seasons series of pictures). The Painting Fool is more fairly compared to Harold Cohen's AARON software which has been creating scenes from a perceived imagination for decades [McCorduck 1991]. However, The Painting Fool is distinguished from AARON by its flexibility: AARON produces scenes only of one particular nature (rooms with people and pot plants) and renders them in only one particular style (which is similar to Cohen's own style). In contrast, The Painting Fool can be trained by any artist to generate scenes of a much more varied nature, and to render them in hundreds of different styles. Although not used in the exhibition discussed here, The Painting Fool also has some critical abilities to assess aesthetic qualities of scene templates and rendered scenes, as discussed in [Colton 2012a]. Such abilities were never intended to be part of the AARON project, as Cohen prefers to retain the creative responsibility of selecting the pieces produced by his software.

### 3.2 Loss of Aura

As discussed in the next section, our aim is to push The Painting Fool along the spectrum from mere tool towards becoming a creative collaborator and then to go beyond this in the same way that Da Vinci (eventually) did from Verrochio – although maybe not with the same huge consequences for the history of art! This aim can be seen in another context related to the *aura* surrounding an artwork. As pointed out in [Monro 2011], Walter Benjamin highlights the loss of the *aura of uniqueness* surrounding an artwork in the age of mechanical reproduction [Benjamin 2008]. Monro goes further than this, to point out that in the age of software as tool, medium and collaborator, the *aura of authorship* surround-

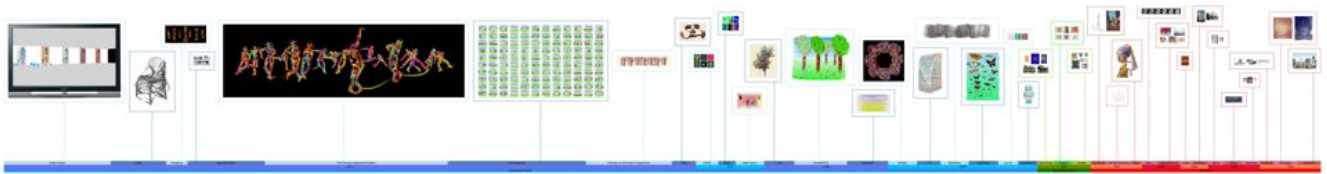
ing an artwork can be lost, “brought about by handing over part of the creative work to a computer program”. He concludes by pointing out that “if a work is presented in the context of high art as the work of a computer program, the absence of the aura of human creation can be profoundly disturbing”. Through our exhibitions and other outreach activities, we can verify that the notion of a software program which will one day be taken seriously as an independent and creative artist can indeed be disturbing. However, we believe that the loss of the aura of human authorship can be supplanted with the formation of an aura around particular computer programs such as The Painting Fool. To emphasise this, we use simple means, such as maintaining a web page in The Painting Fool's voice ([www.thepaintingfool.com](http://www.thepaintingfool.com)), and getting it to sign its pieces, and more sophisticated means such as enabling it to produce stories to frame the production and aesthetic value of each piece it produces, and getting it to exhibit aspects of a rudimentary personality, as discussed in [Pease et al. 2012].

This nurturing of an aura is in line somewhat with the so-called *Istanbul Manifesto*, as described in [Moura et al. 2011], which starts with the idea “To make art that makes art”, goes on to describe how new artificial organisms are reproducing, evolving and producing art, then ends with the provocative statement that “The great artist of tomorrow will not be human”. We do not subscribe to the exclusive view that machines rather than people will be the great artists of tomorrow. It is our hope in the medium term that software such as The Painting Fool will be able to act as genuine creative collaborators with artists, followed later by the software gaining so much creative responsibility that it seems sensible to call it an artist in its own right. We are far more realistic about the timescales involved in producing computer artists than the authors of the Istanbul Manifesto, and we have a much more detailed roadmap (some of which is described below) for achieving this. We argue that this will not diminish the value of human art, but rather enhance its value, as people will continue to cherish connections with other people, and will begin to appreciate this more, as they have a choice between meaningful and inspiring art produced by people and meaningful and inspiring art produced by computer.

## 4 Conclusions and Further Work

The *No Photos Harmed / Growing Paths from Seed* exhibition enabled us to fine-tune the ways in which computer art can be mediated in the art world, in addition to giving us very useful feedback on the impact that The Painting Fool could have in the art world, and that of the field of Computational Creativity in general. It drove technical development of the software, and enabled us to present it and the artworks it produces both in an art production context by comparing it to the processes undertaken by a traditional artist, and in an art-historical context, by looking at the levels in which artists traditionally hand over creative responsibilities to other agents.

Presenting The Painting Fool's work at exhibitions is a very important part of the project. In September 2011, as part of a one night group exhibition at La Maison Rouge in Paris, celebrating the 15th anniversary of the Sony Computer Science Laboratory, we presented a retrospective of ten years of development of the software. In particular, we added new code to enable it to place its own work in a timeline, and then carried out its layout instructions in the actual gallery. The generated timeline and its physical realisation in the exhibition are given in figures 8 and 9. The timeline is split into three periods, described as the *skill* period, where the software largely worked with digital photographs to produce its art; the *appreciation* period, where the software appealed to emotion detection and other machine vision methods to drive its art production; and the *imagination* period, where images were produced by inventing, populating and rendering novel scenes. More details of



**Figure 8:** Schematic of the timeline generated by *The Painting Fool* for the *Growth* exhibition in *La Maison Rouge*, Paris, in September 2011. The red, green and blue areas correspond to the Skill, Appreciation and Imagination periods in the development of the software.



**Figure 9:** Physical realisation of the timeline for the *Growth* exhibition in *La Maison Rouge*, September 2011.

these periods are given in [Colton 2012b]. The last pieces in the timeline, namely 3D galleries, sculptures and animations were presented as a video on a loop. We used this exhibition to highlight the progression of the software, with its early images in sharp contrast – in terms of visual impact and sophistication – with its later images. Our aim was to relate the software to art historic contexts such as progression and periods in an artist’s development of skills, temperament, techniques, subject matter and conceptualisations.

The next exhibition with output from *The Painting Fool* will be called *You Can’t Know My Mind* and will challenge people’s perception that software is simply carrying out commands issued by a programmer. Part of the exhibition will involve live generation of pieces from *The Dancing Salesman Problem* series, but will be interactive. That is, people will be encouraged to pull a full-body pose similar to the figures in the pieces (and this will include jumping in the air). Then, a version of *The Dancing Salesman Problem* will be produced where the person will feature as one of the dancers. This will be enabled with a new module for *The Painting Fool* that uses a Kinect 3D video sensor (normally used for gaming with the XBox) to pick up where the person is in the scene, and the frame in the recorded video to use in the painting, e.g., the apex of the jump, or where they have held the pose. In addition, the software can extract which pixels in the frame constitute their head, arms, legs or torso, which will help in the faithful inclusion of the person of the final piece. An example extraction is given in figure 10.

However, there will be a twist to the tale. Occasionally, the software will pointedly refuse to paint the picture, and may choose to paint nothing at all, or to paint something else, or even to pen a poem, as per [Colton et al. 2012]. Moreover, this refusal will not be based on any random number generator, but rather on physical characteristics of the person’s clothing and/or their pose, driven by the software simulating a mood and an aesthetic for the day (based on it reading articles from the *Guardian* newspaper, as per [Krzeczkowska et al.



**Figure 10:** Input to and output from the Kinect software preparing images of people for rendering in pieces for the “*You Can’t Know my Mind*” planned exhibition. 3D extractions of the whole body, head, torso and a leg are portrayed.

2010] and [Cook and Colton 2011]). The software will indicate the reasons for its obstinacy, which might include showing the person a particularly depressing *Guardian* article. We hope that this will genuinely infuriate at least a few people at least some of the time, and will serve to highlight the naive point of view that software is really just an avatar for its programmer.

In summary, and to recap: with *The Painting Fool* project, we aim for the software to be taken seriously one day as an independent and creative artist in its own right. Our cultural road map will be driven by generative projects with the software and the exhibition of its output as planned above. The technical road map involves (a) combining the software with other programs from graphics, machine vision and AI in general and Computational Creativity research in particular, to multiply its creative intelligence – in particular, we plan to combine it with concept formation systems such that described in [Colton 2002], so that concept formation is at the heart of its creative processing (b) enabling it to frame its work by producing stories – which may contain elements of fiction – about the work it produces and the underlying processes [Pease et al. 2012] (c) implementing aspects of a personality which can be affected by world events and used to drive the production of more thought-provoking and surprising pictures (d) continuing to enable it to create in more domains, which currently include visual arts, sculpture, curatorial gallery design and poetry (e) enabling it to appreciate the work of other artists, to reference their work, to understand artistic movements and find a conceptual and visual niche for itself. All this will be done with reference to the guidelines for developing creative software in [Colton 2009], e.g., handing over creative responsibility wherever possible, and giving the software abilities which could reasonably be deemed skillful, appreciative and imaginative.

An important idea arising from the *No Photos Harmed / Growing Paths from Seed* exhibition described here is that people are interested in a quantification of the ratio of creativity exhibited by the software and the person in collaborative projects. The rather arbitrary figure we gave – of 10% creative responsibility exerted by the software – is a good reference point, and with the projects described above, we hope to engineer, apply and present *The Painting Fool* in such a way as to bring this to 100% in the future.



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**Figure 11:** Process panels comparing the production of *The Dancing Salesman Problem piece* (top row) and *the Generation of 13 Nudes piece* (bottom row), starting from the same genesis: XML code.

## Appendix - Process Panel Texts

The process panels as presented at the exhibition are given in figure 11. In the pairs of texts below, the first is from the scientist (top row in figure 11) and the second is from the artist (bottom row).

### 1. Seed File - Definition of Creative Parameters

Variables and major categories are assigned. For these works, variables include subject/object, number and size of frames, colour palette, and medium/stylistic technique.

#### 2a. Subject/Object

As a piece constructed of individual elements, the chosen object is the nude figure. A series of images are generated from context-free design grammars with random aspects ensuring variation.

#### 2b. Subject/Object

As a piece constructed of individual elements, the chosen object is the nude figure. A series of images are chosen from a library of sketches that are then used as a base for the subjects in the piece.

#### 3a. Frames

A template is used to create a series of frames into which a figure is inscribed and scaled to fit the width of the box, with larger figures brought to the foreground. The result is variation in the size of the figures and an illusion of depth of field.

#### 3b. Frames

Art papers in a selection of standard sizes are used in collage to create a series of frames of varying sizes into which each chosen figure is inscribed. The result is variation in the size of figures and an illusion of depth of field.

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#### 4a. Scientific Imagery

One of the main processes in producing the artwork involves turning paint regions into a single continuous line. Doing this amounts to solving – via heuristic means – an instance of the Travelling Salesman Problem, which is classic Computer Science.

#### 4b. Poetic Imagery

An additional decision was made in the process to imbue each of the figures with characteristics from the 13 nudes described in Anne Carson’s Poem “The Glass Essay”. The highly graphical text is used to develop each figure as a distinct character.

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#### 5a. Colour Palette

A standard colour palette from “The Colour Index” is chosen to randomly map shapes to, and used as a guide in mixing paint colours for the final image. The shapes are turned into a single line covering the whole picture space.

#### 5b. Colour Palette

A standard colour palette from “The Colour Index” is chosen as a constraint, and used as a guide in mixing paint colours for the final image.

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#### 6a. Artistic Medium/Stylistic Technique

Acrylic paint, a traditional artistic medium, is chosen to simulate in the final rendering process, for its vibrant and dynamic nature. Random aspects are introduced to add to the hand-produced look and feel.

#### 6b. Artistic Medium/Stylistic Technique

Watercolour paint, a traditional artistic medium, is chosen for its ability to create random, and sometimes unexpected visual results, depending on the paint to water distribution. In this way, artistic control is handed over to the medium.

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