Using Generative Art, Data-Storytelling and Artificial Intelligence based Games as Educational Resources to Generate Awareness About Falls Prevention

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Abstract

This paper provides an overview of a generative art-based project, namely NO*fall*.art and shows various of its experiments and artworks.

First, the origins and motivation for the project are explained, including the serious challenge of falls in adult population and the importance of raising awareness to avoid or reduce related risks and fears. Various diverse perspectives are highlighted, such as the relationships of this work with the increasing demand for "*Responsible AI*", as well as connections to UN's Sustainable Development Goals, and references to the author's previous research on AI-based Fall Detection Systems (FDS) using open-data FALL-ADLs (activities of daily living) datasets.

We discuss an approach to integrate several disciplines: Agile Project Management, Data Science, Artificial Intelligence, Gamification, and Storytelling using GENERATIVE ART as the "meeting point" or hub to link the outcomes of this hybrid approach in a narrative space with diverse resources for divulgation and education.

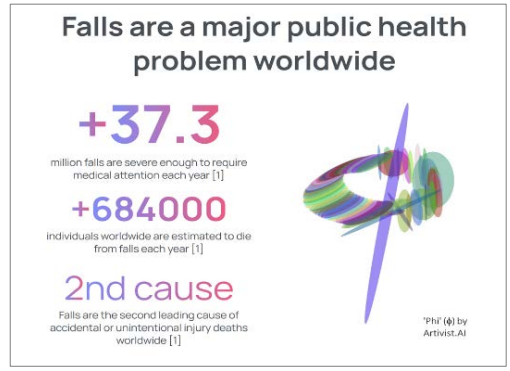

Fig 1. The "hard" truth about falls. Note: Fall data consulted from WHO report [1].

With a lifelong passion for cybernetics, art, maths, robotics, and artificial intelligence, this project is also influenced by the work of his parents, and milestone events such as the Cybernetics Serendipity Exhibition [2], he would dream attending (in person).

The author's shares how he used these "purposeful" generative-hybrid artworks

for adult/senior learning about fall risks, as well as educational resources for other teaching and academic activities.

Thus, the NO*fall*.art project's outcomes include generative data-art pieces, AI-generated contents, several games collection in the A+D+A Playground (both digital and physical), data sonification experiments, creative hybrid-art project management "good" practices, educators' guidelines, online gallery, physical AI/data art-pieces, among others.

Fig 2. NOfall.art Gallery

The importance of having a diversity of resources (using generative art) is discussed as a way of reaching larger and more diverse audiences, while some of these artefacts are expected to evolve with the interaction of the public.

Fig 3. Could games influence our mindsets to create new behaviours?

The author will share some testimonials and personal experiences of use and implementation of these artefacts and resources in the context of life-long educational activities (university master).

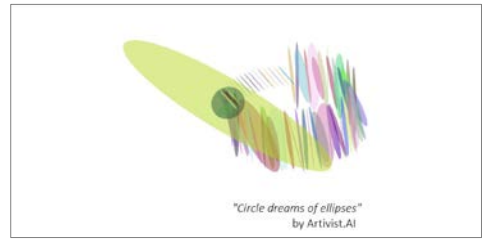

Fig 4. How could your "dreams" impact your "algorithms" – or how expectations change your habits?

Additional insightful observations with elder senior adults and kids who have learned about AI, Neural Networks, Data-driven generative art and about falls prevention by playing some of the NO*fall*.art games will be shared.

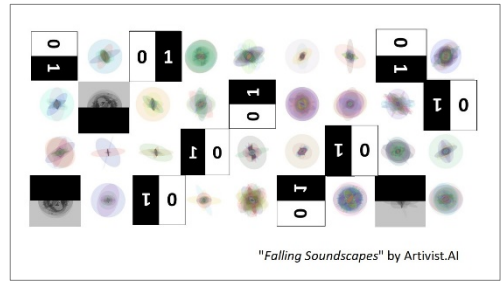

Fig 5. FALLsonancIA: Generating Soundscapes in a World Without Falls?

Finally, some conclusions and future works are proposed on the great opportunities and value potential of integrating AI, Data and Generative Art as inspiration for creative projects as well as a source of resources for education, and ultimately to produce positive social benefits!

Background and motivations

The starting spark of this initiative was a recurring question that I have been "brooding" for quite some time. Namely: "Can AI, data and art be *hybridized* to influence change for good purposes?".

Several responses can be immediately considered, from the absolute "yes, of course!" to the dubious one: "well, maybe" or the more ambiguous "it depends". However, for me this sparking-question ignited an internal dialogue leading to a deeper exploration and ideation exercise, imagining examples of scenarios and good causes to the make the case for an affirmative answer. The resulting "proto-ideas" also contributed to various conversations that, far from providing "definitive conclusions" further fostered a curiosity, interest and ultimately a determination to do something "seriously" or as I like to believe and live by: "act to change!".

A journey into 'terra incognita'

Not accepting the first viable answers did not result in a resolved “final state”, but rather became the departing point of a "journey" that I decided to undertake myself. Like a visit to a "terra incognita", my approach has been based on a playful observation, exploration, sharing, and lots of experimentation. Therefore, I have conceived this initiative as a "work in progress" (WIP) space to share questions, ideas, findings, experiments, and challenges, which I encounter in this endeavour to create a route to a previously uncharted destination.

“Uncharted” territory does not necessarily mean totally “unknown”. There are numerous examples, projects and resources about data art (data + art), decades of algorithmic or generative art, as well as "art-via-AI" such as the increasingly popular "AI-based" neural style transfers, AI-assisted musical compositions, or recent AI-powered DJ tools, etc. There also are initiatives based on *artivism* (that is "art + activism": doing activism through art, and vice versa, doing art with a social responsibility backbone). I find many of these experiences very inspiring.

Even though this project started as a personal journey with uncertainty at its core, I had from the very start an strong conviction and vision that such a hybrid approach can lead to promising results.

Art CAN change mindsets

It is outside the scope of this article to debate or go deeper into the discussion about what is generative art (or what is not). However, I confess that I am convinced of the influence of art and creative ideas to change the way of thinking. It is enough to bear in mind that even a porcelain urinal “upside down” (DuChamp, “Fountain”. 1917) can not only be a work of art, but also become a milestone that radically changes the way of understanding art forever and that it is considered one of the most influential works of art of the 20th century.

From an artistic-creative point of view, the objective of this project has been to provide an aesthetically diverse space, in a way potentially immersive and appreciative that invites to interact (directly or indirectly) with the underlying data of the reality of the falls.

For this reason, I wanted to exploit the multiplicity of options that generative art provides to experiment with a certain “abundance mentality”. An expectation behind every artwork, game, installation, experiment here is to be able to combine these creative elements with storytelling and real data to influence change.

Conveying a vision with Generative Art

As mentioned earlier, one significant aspect of generative art is its immense richness: diversity of approaches, techniques, algorithms, tools, mediums, etc. These includes Artificial Intelligence based systems and models as well and translates into a discipline that is in fact an open creative scape for AI professionals. Even though this can mean different things and opportunities for them.

As pointed out in the XXI's edition of the Generative Art conferences, relying on over 35 years of generative art experiments, Celestino Soddu affirms that "*we have to accept that it's difficult to make a unique and final definition of Generative Art*" [3] and goes on to highlight key points such as *"Generative Art is the human ability to design generative systems."* [3], explaining the role of Generative Systems and well as of the resulting Generated Events.

*"**Generated Events**, all different and unique as natural individuals, **represent the human vision that was at the basis of each generative project**."* [3] - Celestino Soddu

Another view I often express to appreciate the potential of this approach is one that conceives generative art as the result (being an artwork or artistic creation) that is based - at least partially - on the use of an "*autonomous*" production system. This does not mean that such system or its results are totally "unsupervised", but it does mean that the artist-creator in this case only exercises control or influence over a set of rules (those that define and restrict the performance of the generative system) and of a set of parameters or variables that allow the creative activity to get "started". That a work is the result of a generative art process, entails or requires multiple decisions on the part of the artist-creator-designer.

Such decisions are undoubtedly an important element of this artistic discipline. And at the same time, a reflection of the preferences and aesthetic judgments of the people involved. Another noteworthy aspect is the myriad of options that these creative techniques often offer.

This abundance does not necessarily mean that everything that results from these processes is of aesthetic or artistic value. However, it does allow an ideal space for experimentation and active exploration, which may in turn translate into the desired compelling vision. In the context of this project a vision of fall awareness and absence of failure!

"*Not failing*" by not falling

What is in a name? Or why is it called "NO*fall*.art"? Well, falls are like an "avoidable failure event" and "NO*fall*.art" when read in Spanish sounds like "*no fallarte*" (literally meaning: "not failing you"). Considering the above, the project is conceived as a "call to action" with which I invite participants, public and key stakeholders, to get up close and experiment with "generated" falls.

For example, I encourage the public to experience and become aware of these events by "playing games" that incorporate generative art experiments, such as the FALL Memory Game (FMG). FMG is a variant of the legendary memory game that I have designed using the images generated with data obtained from sensors attached to people who participated in fall data collection [4].

Often, participants do play with someone else and share the results, which in turn helps influence other people (relatives, children, adults, seniors, co-workers, etc.) to become aware of the problem of falls. At the same time, the participant also discovers some ideas about what AI (Artificial Intelligence, data science, etc.) can contribute to generative art and vice versa. As a journey that begins with these experimentations as a kind of first step, the invitation is open to share these first-hand experiences and help raise awareness among other people. A trip that I hope does not end in autumn, because the falls also matter the rest of the year.

The HARD truth of falls

At the heart of this project stands the serious challenge of falls in adult population and the importance of raising awareness to avoid or reduce related risks and fears. [See Figure 1]

Many people are unaware of how important falls are. In my own experience, every time I share these facts with people (who did not know about them), they are usually surprised and often overwhelmed. Almost everyone knows someone who has been injured by falls.

But translating "large numbers" into a person's reality is not always easy. So, I invite you to forget the "big data" for just one minute and consider falls in a close-up small-context, with what I call "The HARD Truth About Falls": a fall takes place in a fraction of a moment - in a blink of an eye – literally, in less than a minute! And falls can and do affect anyone.

Sadly, there are many falls happening as you read these lines [1] and despite their short time span, a fall can (in a fraction of a minute) change a life significantly. To raise awareness about this "hard truth" and the importance of fall prevention, I designed an animated collage, which I named "The One Minute Gauge" (OMG! Not to be confused with the colloquial "~~*Oh my gosh*~~!"), to illustrate what happens during just a minute [See Fig. 6]. Each rounded-square image represents a fall that required medical attention.

Fig 6. The One Minute Gauge: A generative composition to appreciate

In the context of this significant health challenge, I propose the application of a hybrid approach.

The value of a hybrid approach

As mentioned above, the approach of this project integrates several disciplines: Agile Project Management, Data Science, Artificial Intelligence, Gamification, Data Sonification [5], and Storytelling, as well as Generative Art, serving this last one as the "core ingredient" which links the various outcomes in a narrative space with diverse resources for divulgation and education.

The AI + Data - Agile WAVE lifecycle

I have applied this WAVE lifecycle in my own research-projects on Fall Detection Systems using AI [6], together with actual fall datasets [4].

By following guidelines and doing activities from the WAVE approach, I can select data sources that are aligned with the goal and vision, ensure data is relevant, ethical, and available, to then proceed to design and build algorithms and models that will ultimately "transform" such input (data, parameters, design constrains) into generative artworks. I often start with a simple element, which by iteration then "multiplies" and expands… In this context from a single "Generated Event" of a fall to an array of falls, for example, using statistics as constraints to the expressions of the generative system.

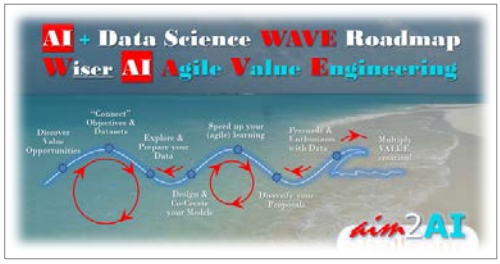

Fig 7. The WAVE Lifecycle is a hybrid approach for AI+Data+Art projects [20].

Another discipline in this hybrid methodological mix is **Gamification**: which I define as the discipline of applying game mechanics, dynamics, and techniques in non-game contexts.

The importance of games as social artifacts is well established and accepted. In part, thanks to the influential work of Johan Huizinga: Homo Ludens [7]. Inspired by this title a recent exposition in Madrid, named "Homo Ludens: Videogames to understand the present" has offered a multidisciplinary, multi-perspective debate about the challenges and opportunities of these significant social, economic, and educational activities and industry [8].

Games for motivating motivations

From a learning design point of view, my motivation in using games as a vehicle to influence behaviour changes can be associated with the well-known motivators of gamers as put forward in Bartle's taxonomy [9] and the value opportunity of using games for "explorative" learning.

Using Gamification and games in the context of Executive Project Management Education is also something I have experienced as an effective toolset to challenge assumptions and help learning on how to shift the status-quo [10]. Part of these experiences are based on the use of questions to engage diverse stakeholders into a "larger conversation".

***"Responsible AI"* and Sustainable Development Goals**

It is precisely in the context of larger-significant stakeholder conversations that due reference is needed to the ethical & responsible use of AI (and technology). A valuable body of knowledge to inspire action in this regard are the UN Sustainable Development Goals (SDG) which can provide additional context for our narrative and data sourced storytelling. Ultimately, we can relate the challenge of falls in adult and senior population with Goal 3 Good Health & Wellbeing: Ensure healthy lives and promote well-being for all at all ages. Two initiatives are worth mentioning.

- AI for Good. Presented with the question: *What if AI were developed to serve humanity rather than commerce?* And the vision *"A world*

where we can harness the full potential of emerging technologies towards creating positive social change." [11]

- UN's "Be the Change" initiative (2018): providing an opportunity for all of us to better "walk the talk" when it comes to the SDGs. [12]

Both pf them are sources of inspiration in my work in Artivist.AI and NO*fall*.art.

Why embrace Generative Art-based educational resources?

In this section I reflect on the importance of having a diversity of resources (using generative art) as a way of reaching larger and more diverse audiences, while some of these artefacts are expected to evolve with the interaction of the public.

One of the benefits of being an active educator is that I encounter many opportunities to use and apply "*purposeful*" generative-hybrid artworks for adult/senior learning about fall risks, as well as educational resources for my teaching and academic activities. Here are some highlights:

- **In business context**: Generative Art is a creativity booster. I used it with diverse groups, and often when presented to executive and managerial teams in the context of "Systematic Innovation" and "Creative Design Thinking", "Lean Inception" workshops it reminds participants of – and contrast with – the Heuristic Ideation Technique (HIT) [13].
- **Open sourcing**: It can easily leverage with other initiatives such as Open Education Resources (OER). For example, as relying on open data, open-source, frameworks, platforms, etc.
- **Positive community feedback**: received and increasing interest, as I have personally presented these experiences and resources in diverse professional communities. For example, events like University: Future Festival [14] and the Agile Trends Fest [15].
- **Observations from the classrooms**: Various students in Master Classes I teach "gets inspired" to consider AI + Data + Storytelling, etc. in their projects, both at the university and in their professional works.
- **Visual and engaging resources** to teach creative project management "good practices" with project-based work! *NOTE: It is worth noting that the role of project-based work and generative approaches in the context of higher education have been featured in the first Generative Art conference (1998)! [16], including reference to design learning as an iterative process.*
- **Beyond the "formal" classrooms**! The ludic-social side of games, make some of these resources attractive to non-specialized public. With very little to no explanation, I have seen kids and seniors start playing the games. And most importantly, begin to ask about falls. This has shown some potential for influence of kids and youngers on their parents and grandparents. Thus, elder relatives and adults become significantly more aware of the risks of falls.

Questions as central part of the educational journey

Inquiry is also a key practice in these resources. Three recurring questions I pose to students include:

1. When selecting and/or defining your next project ("BIZ + EDU + TECH + ART"), what role(s) should/must the human-, social-, eco/green-, sustainable sides play? Why?
2. How could/should AI + Data Science + Gamification + Storytelling + [your "discipline": Generative Art] …help?
3. What are you going to do about these…?
4.

Exploring the A.D.A. Playground

The NOfall.art project's outcomes include generative data-art pieces using AI-generated data, and a growing game collection in the A.D.A. Playground. These games are digital, physical and hybrid. Also, there are data sonification experiments as well as a creative hybrid-art project management "good" practices and educators' guidelines.

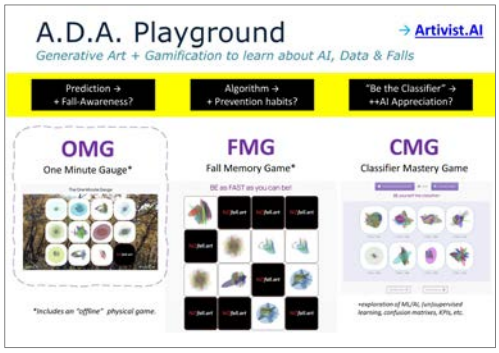

Fig 8. The A.D.A Playground: a hybrid experimental landscape (Art + Data + AI)

I highlight three games that includes generative artworks, as well as three explicit hypotheses in the form of questions to be explored.

1. **One Minute Gauge** (OMG): From Prediction to Increased Fall Awareness?
2. **Fall Memory Game** (FMG): From Algorithms to Prevention Habits?
3. **Classifier Mastery Game** (CMG): From "being" a Classifier to a more positive appreciation of AI (+Art & Data)?

There is also an implicit timeline reference between Past, Present and Future in the design of these games, and the sequence in which they are played or used.

One Minute Gauge: "Future ← Past"?

Is there any relationship between our Past experiences and our abilities to Predict the Future? Generative art can create imaginary scenery that has never been seen before. But what if one can or want to generate awareness of an existing challenge. This is precisely the case with understanding that it only takes a fraction of a minute to change a live (with a fall).

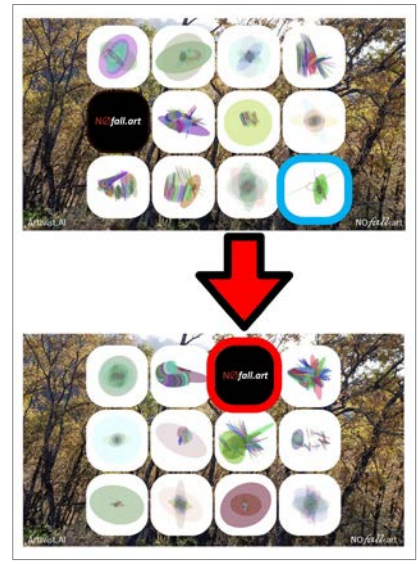

Fig 9. The One Minute Gauge: A generative composition to appreciate how fast a fall can change a life!

OMG! This are your challenges:

a) Estimate (count) how many falls happen in 1 minute!

b) Observe & estimate how often does the NO*fall*.art “dark fall” moves to a different place?

c) Estimate (“anticipate”) where the next “dark fall” fall will be?

Fall Memory Game (FMG) + Thinking Algorithmically: “Past → Present”?

The challenge: *Think Algorithm*(*-ically*) FAST! I invite you to play and experiment with a web "classic": a memory game! In my case, I named it the “Fall Memory Game" as the front faces of the cards are decorated with artworks that I created using sensor data from FALLs/ADLs (Activities of Daily Living) and generative-data-art algorithms. Your challenge is to discover all the pairs of cards as fast as possible - ideally under 48 seconds! Why?

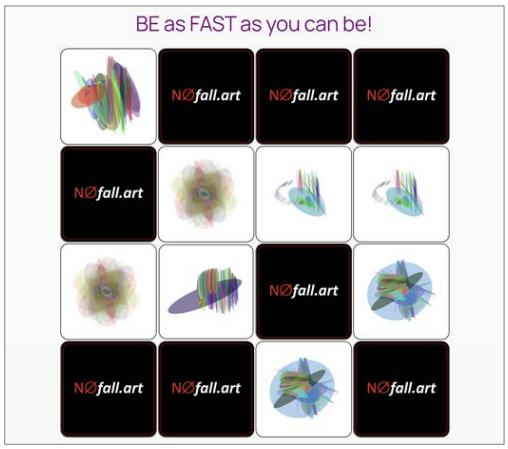

Fig 10. The Fall Memory Game: What’s your next play? What’s your “algorithm”?

To do your best, I encourage you to think algorithmically, by considering the steps you can follow systematically to have a great consistent performance. You will be able to compare yourself ("face-off") against "the machine" or AI performance.

How fast is this? Compared to what? In present times, AI & Machine Learning are becoming increasingly popular and have found enormous interest and applications thanks, in part, precisely to the fast computation infrastructures available today. At the core of this high performance are numerous optimized algorithms.

What is an Algorithm and why care?

In simple terms, an algorithm can be defined as a set of instructions or "steps" to perform a certain task. In computer science, algorithms are used all the time - from programming "simple" functions or routines to developing advanced artificial intelligence applications. One can also say that "any" well-defined (unambiguous) process to perform an operation, to resolve a problem or to achieve an objective, could be seen as an algorithm.

One way to create faster algorithms is to optimize them for simplicity and to have the least number of steps. You too can experiment with algorithms by being (explicitly) aware of how you play the Fall Memory Game (FMG).

Could the generative artwork on Figure 4, represents a search for *algorithmic perfection*? Is it a circle that evolves into a sequence of ellipses? Or perhaps, the other way around, a series of ellipses that “dream” in search of perfection? So, how do your dreams – expectations,

aspirations – affect your habits? How could these (habits), help prevent falls, associated risks, and raise awareness?

A "meta-algorithm" for the FMG

1. DISCOVER PAIRS! This step is the "essence" of the game. You must find all the pairs of matching cards, by "flipping" them two at a time. When you flip two cards that DO NOT match, after a few seconds they are flipped back to their reverse faces. When you flip two cards that DO MATCH, they stay visible, and you can continue flipping other cards. YOUR GOAL is to minimize the number of flips needed - and thus minimize the time needed - to discover all pairs. (This Step 2 is "repeated" if there are matching pairs to be discovered).

2. CHECK YOUR SCORE. Once all matching pairs are discovered, you can see your score message and some points to think about. You can learn more by visiting the "Score & Stats" tab.

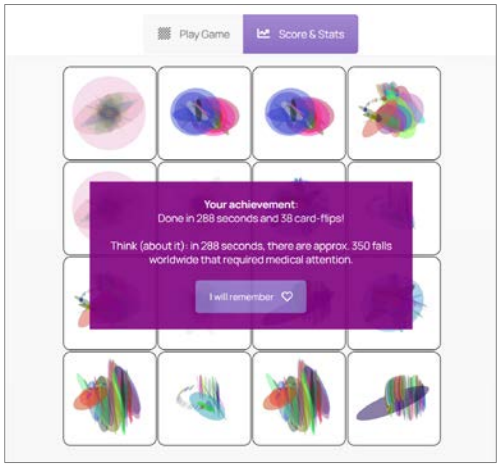

Fig 11. These scores incorporate the "signalling principle" to reinforce learning.

The *Signalling Principle* [17] *"…states that learners will learn more effectively when signals are added to highlight and provide context to the essential material*."

3. LEARN AND IMPROVE. Here comes the fun! Now, it's time for you to "optimize" how you perform Step 2 and find a way to play consistently FAST by thinking algorithmically. Do your best, ENJOY & HAVE FUN!

Questions and call-to-actions:

1. Do you think an Algorithm or AI (Artificial Intelligence) could do better than you...?
2. "Compare" your results against an Algorithm by clicking the "Benchmark" button [coming soon].
3. How could you improve your performance...? ...and optimize "your algorithm"?
4. How can falls be prevented? ...by "thinking algorithmically"? (Habits?)
5. Play again to achieve better results!

Be the Classifier to "beat" the Matrix! "Present → Future"?

In this game I invite you to become a Fall/ADL Classifier... and to compare yourself ("face-off") against some Artificial Intelligence (AI) models in a classification task. By playing and experimenting with The Classifier Mastery Game (CMG) - aka "Confusion Matrix Game" - you will learn about AI-based classifiers, their performance and related measurement instruments, such as the Confusion Matrix (CM).

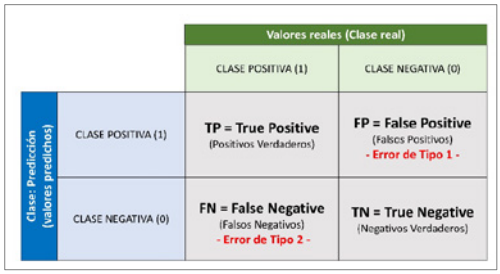

Fig 12. A simple presentation of a confusion matrix as a 2x2 table.

What is a Confusion Matrix?

A Confusion Matrix (CM) is a very useful measurement instrument used to understand and communicate the performance of a ML based classifier. [See Figure 12]

You can learn these concepts with a simple hypothetical fruit classifier. Suppose we have a system that automatically selects ("sorts") the apples that go through a conveyor belt. In Figure 13 you can see its performance displayed in a Confusion Matrix.

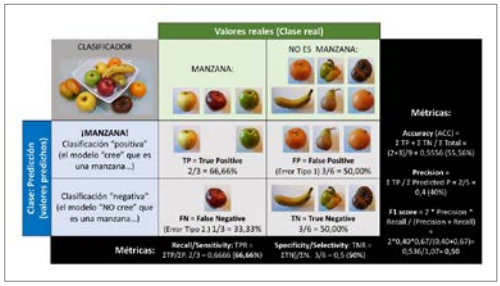

Fig 13. A real-hypothetical fruit classifier Confusion matrix [18]

What is it like to be a ML Classifier?

AI/ML (Machine Learning) classifiers are mathematical or computational models that are "trained" to "learn" patterns that are embodied in data (often in large datasets), so that when they are presented with new data/samples, they can classify them based on their previous learning ("experience").

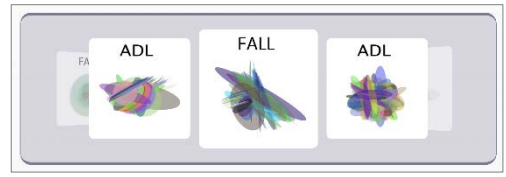

Fig 14. Train yourself to identify Falls VS. ADLs (Activities of Daily Living)

To train an AI/ML model, different techniques can be used. In a type of machine learning - known as Supervised Learning - the classes of the samples used during training are known - or as usually said, the samples are "labelled". Thus, a first step in the creation of an AI-classifier, is to "train" it by "showing" it some (labelled) samples.

To ensure "fair-playing" against the AI & machine, you get a chance to train yourself [See Figure 14], which is your first step to "become" a Fall/ADL classifier!

Steps to BECOME a GREAT classifier:

1. Get some (more) training in the CHALLENGE tab!
2. Classify each of the artworks above as a FALL or an ADL (Activity of Daily Living). DO YOUR BEST!
3. Click on "Show My Metrics" to see your results... ...and/or go to the "Confusion Matrix" tab to learn more.
4. Return to play & experiment again!

Questions and call-to-actions

1. Could an AI (Artificial Intelligence) do better than you...? When and Why?

2. "Compare" your results against some AI-based models by clicking the "AI Benchmark" button [coming soon].
3. What could you do to improve your performance...? How could an AI's performance be improved...?
4. How can falls be prevented? ...and/or predicted/detected by "AI/ML-based classifiers"?
5. Play again to achieve better results!

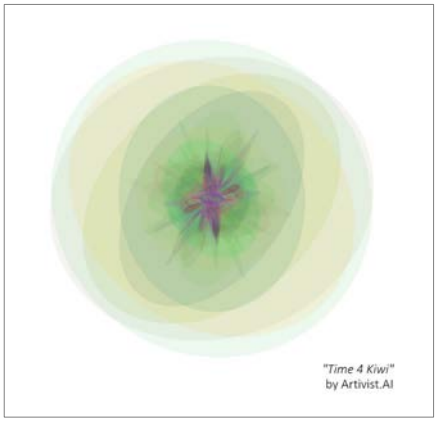

*Fig 15. **KIWI**, Fall or ADL (Activity of Daily Living)? What's your best guess?*

WIP thoughts back to the future

It would not be appropriate to draw conclusions for a project that is conceived as a Work-In-Progress creation. Starting with an exploratory mindset it may have seemed that there were few initial opportunities ahead, but the reality proved quite the opposite. One good thing about generative art systems and this type of creative work is that at some point the systems seem to have a life of their own… and what was until a while ago, a scenery of scarcity of data (like in the case of Falls and the need to do data-augmentation), it becomes a whole new landscape of abundance and unexplored possibilities.

As Soddu pointed in the previously quoted paper "*Making an artwork that never stops to amaze you, gradually bringing into focus unprecedented aspects of your idea, is undoubtedly the ultimate in creativity. And Generative Art has this undeniable quality*" [3].

I could not agree more with that statement. And it was quite my very personal feeling when several of "my" fall-generated artworks started to resemble Kiwi fruits (See Figure 15) and these triggered other relevant connections and explorations.

While there are companies nowadays already offering remote care services, including armbands, "smart-watches", helmets and other artifacts to automatically detect falls, there is still a long-long way until these become globally accessible to all population. And even then, we might wonder how to train such AI-based systems to ensure these are fair and avoid falls positive/negatives and/or unethical use of data.

Perhaps in this imaginary-generative journey one may also wonder about the possibility of **a world without falls**, which could arguably be **the ultimate design-engineering art challenge!**

Though on "gravity-forced" Planet Earth this could be technically- or cost-unviable, perhaps we might consider entering the virtual world games realm. As Bartle argues *"Virtual worlds are works of art. I refer to their creators as "designers," but that's a misnomer; really they're artists"* [9]. So, it could well be, that (generative) artists will have a

significant creative role and place in such an ambitious endeavour.

And while that uncertain future unfolds, we might be back to the present, and explore other earthy-human challenges by using the hybrid toolkit promises of mixing AI, Data, Sonification, Generative Art, Gamification and Storytelling.

A Fall is not only an undesired (accidental) event, nor is it just a Generated Event. It also refers to a season (autumn) that represent a chance for renewal – as old leaves fall, they "create the space" for new ones to emerge and grow later [19]. Should this "cyclic" metaphor emphasize the renewal and generative nature of education? Hopefully, this paper and the project/artworks it includes has inspired you to keep playing. Game is NOT over!

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