

Computer generated car design

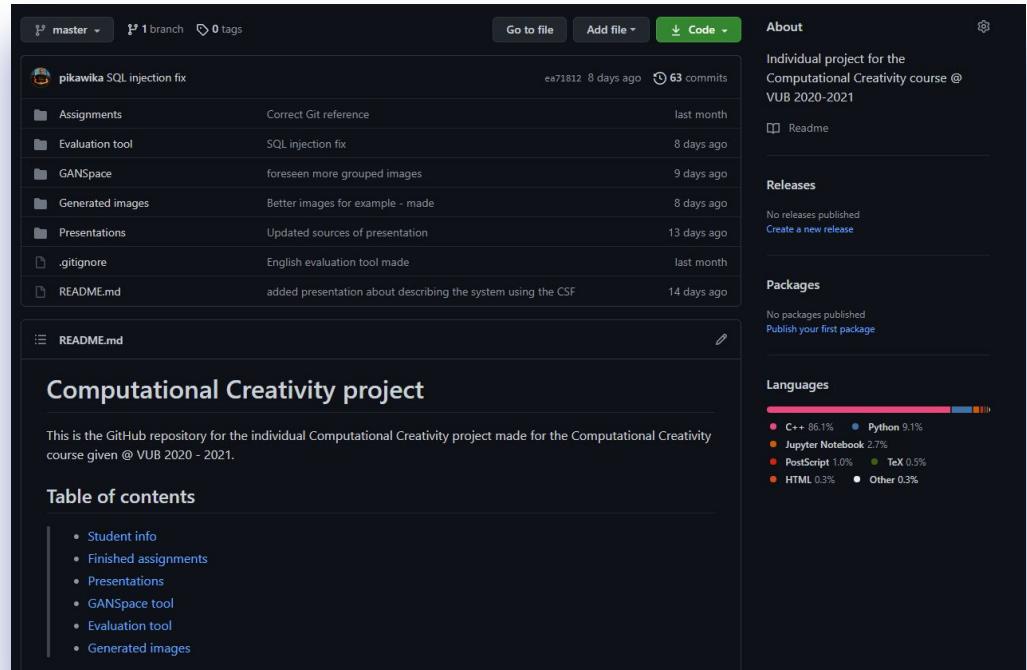
Discussing the creative system by Lennert Bontinck

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On the menu

- Creative domain and aim
- Relevant literature
- Implementation of the system
- Internal evaluation
- External evaluation
- Conclusions
- ... In 20 *enjoyable* minutes



The screenshot shows a GitHub repository page for 'Computational Creativity project'. The repository was created by 'pikawika' and has 63 commits. It contains files like 'Assignments', 'Evaluation tool', 'GANSpace', 'Generated images', 'Presentations', '.gitignore', and 'README.md'. The 'README.md' file is expanded, showing its content. The page also includes sections for 'About', 'Releases', 'Packages', and 'Languages' (C++ is the most used language at 86.1%).

About
Individual project for the Computational Creativity course @ VUB 2020-2021
[Readme](#)

Releases
No releases published [Create a new release](#)

Packages
No packages published [Publish your first package](#)

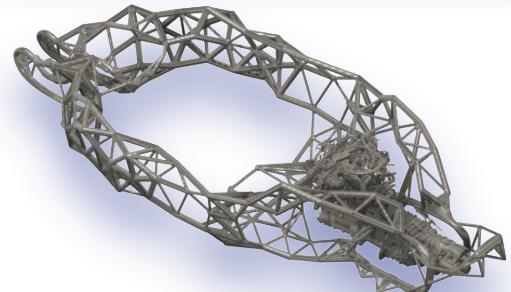
Languages
C++ 86.1% Python 9.1%
Jupyter Notebook 2.7%
PostScript 1.0% TeX 0.5%
HTML 0.3% Other 0.3%



Why car design?



- I'm a nerd and car geek
- Access to multiple juries
- Fascinating past work
- Interest by big brands
- ... It's just cool



Pette, B. (2016). *The world's first ai-generated car*. Retrieved February 17, 2021, from <https://blogs.nvidia.com/blog/2016/07/26/hack-rod-car-ai/>
Girish. (2020). *A revolutionary hypercar built for the 21st century*. Retrieved February 17, 2021, from <https://www.czinger.com/about-21-c>

Aim of the system: initially



- Collect a training set by scraping car auction sites
- Create GAN capable of generating novel car designs
- Let GAN determine what merges of car brands look like
- Find intermediate models when fed oldest and newest car design
- Detect existing style elements in generated designs
- ... Create an awesome project



Aim of the system: reality strikes

- Famous LSUN-Stanford car dataset contains 2M+ images
- StyleGAN2 takes months to train with my computer
- Best case, I would just have another car generating StyleGAN2 model
- ... What now?



Aim of the system: making it viable

- Use less images
- Probably have a GAN producing garbage
- ... Call it creative!



Poor
performing system

Creative
system



Aim of the system/project

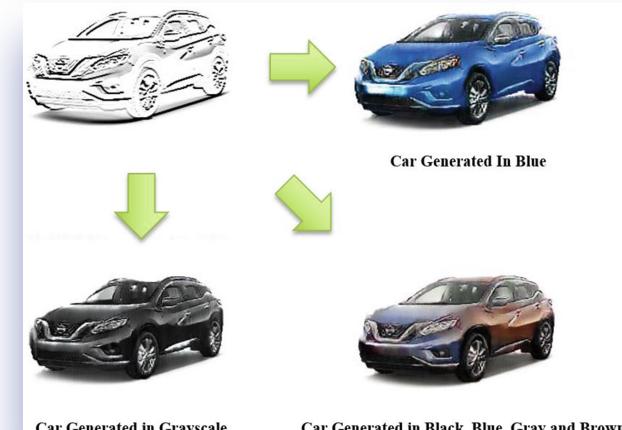
- Extend GANSpace tool used for creative space exploration
- Discuss a pre-trained StyleGAN2 model's creativity
- Have a discussion on generative vs creative system
- Do an extensive external evaluation
- Provide an open source evaluation tool
- ... Hopefully add value to the field



Important literature



- StyleGAN2
- GANSpace (Hätkönen et al, 2020)
- Creative intelligence - Automating Car Design Studio with GAN (Radhakrishnan et al, 2020)
- ... And many more



(Radhakrishnan et al, 2020)

Karras, T., Laine, S., & Aila, T. (2018). A style-based generator architecture for GAN. CoRR, abs/1812.04948. <http://arxiv.org/abs/1812.04948>

Hätkönen, E., Hertzmann, A., Lehtinen, J., & Paris, S. (2020). Ganspace: Discovering interpretable gan controls.

Radhakrishnan, S., Bharadwaj, V., Manjunath, V., & Srinath, R. (2018). Creative intelligence -automating car design studio with generative adversarial networks (gan). In A. Holzinger, P. Kieseberg, A. M.

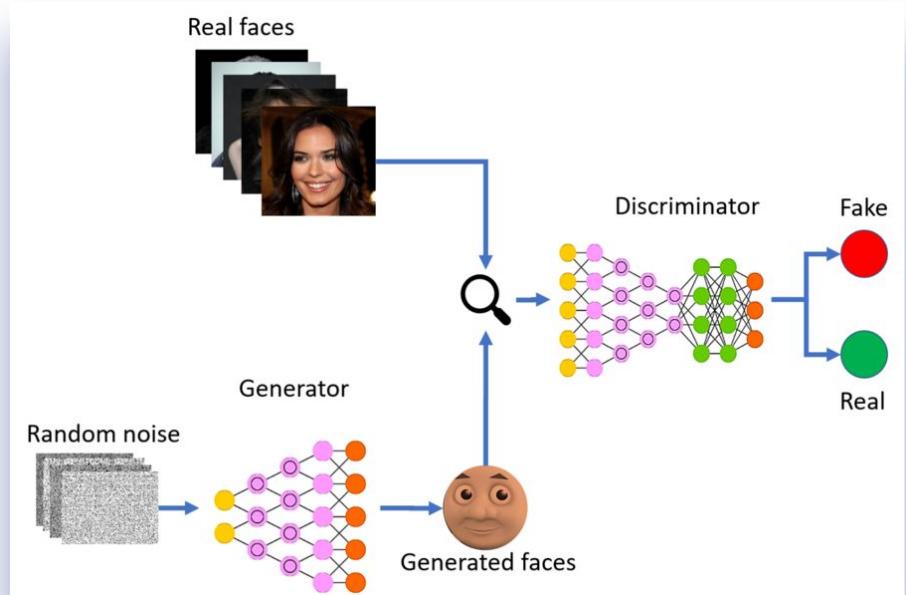
Tjoa, & E. Weippl (Eds.), *Machine learning and knowledge extraction* (pp. 160–175). Springer International Publishing.



Understanding GANs



- Cat-and-mouse game between generator and discriminator
- Iterative process with risk of becoming a cloner
- ... And a lot of very complex math



The need for GANSpace

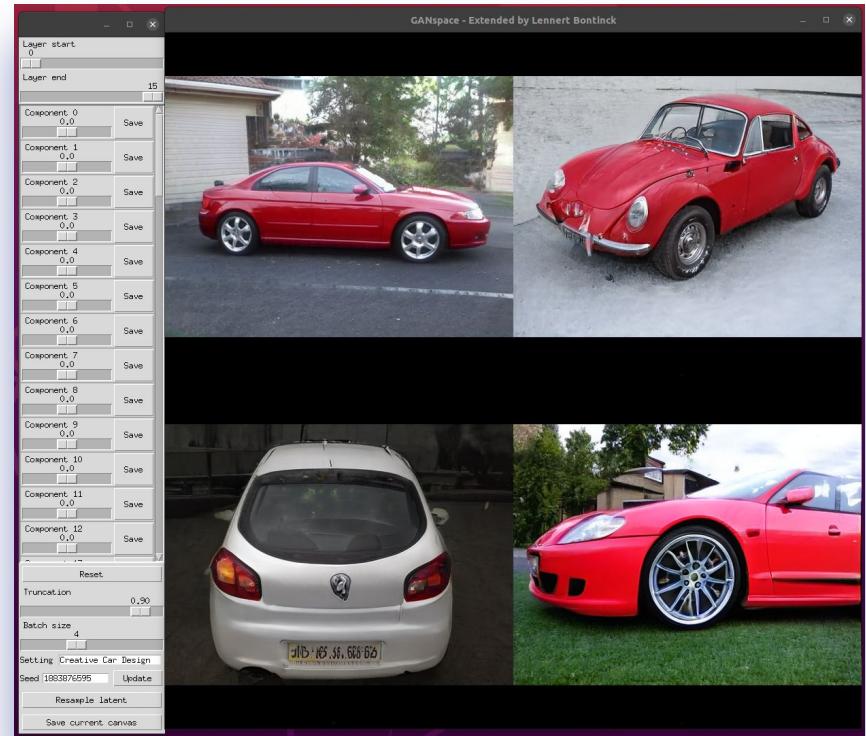
- Validate the StyleGAN2 model has learnt something
- Explore the conceptual space
- Take a look inside the black box
- ... But it's not that easy



The need for an extended GANSpace



- Making the setup guide a setup guide
- Creating a one-line initialiser
- Allowing to export the canvas
- Document the generation hook for future extension
- ... People seem to be thankful



Where are we? 🤔

- Creative domain & aim ✓
- Relevant literature ✓
- Generative system ✓
- Conceptual space exploration ✓
- Internal evaluation ✓
- ... External evaluation?

The screenshot shows a GitHub repository page for 'pikawika SQL injection fix'. The repository has 1 branch and 0 tags. It contains 63 commits from ea71812 8 days ago. The commits are listed as follows:

Commit Message	Time Ago
Correct Git reference	last month
SQL injection fix	8 days ago
foreseen more grouped images	9 days ago
Better images for example - made	8 days ago
Updated sources of presentation	13 days ago
English evaluation tool made	last month
added presentation about describing the system using the CSF	14 days ago

The repository has a README.md file. The content of the README.md file is:

Computational Creativity project

This is the GitHub repository for the individual Computational Creativity project made for the Computational Creativity course given @ VUB 2020 - 2021.

Table of contents

- Student info
- Finished assignments
- Presentations
- GANSpace tool
- Evaluation tool
- Generated images

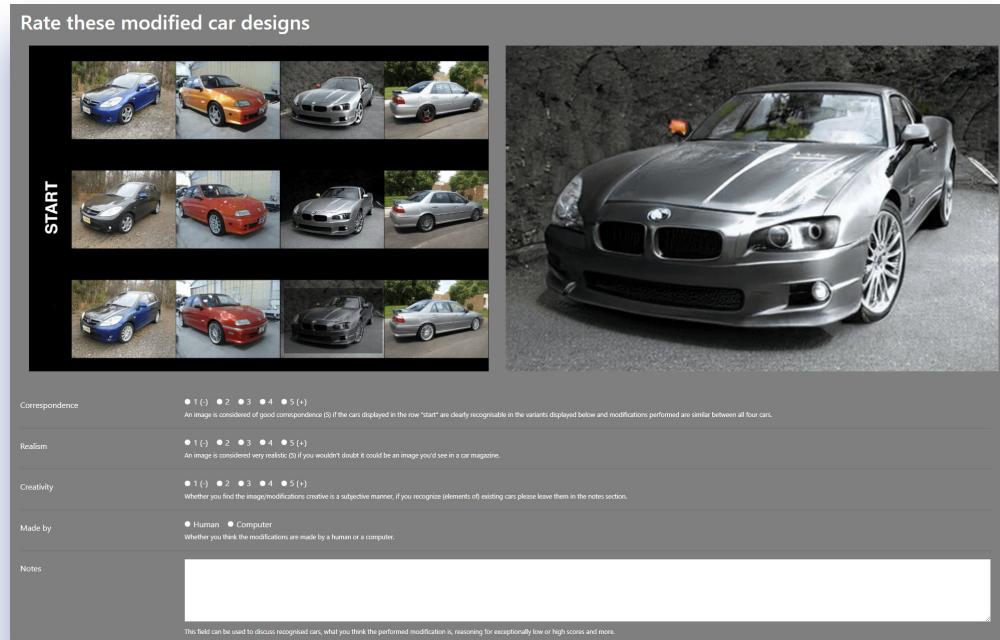
On the right side of the page, there is an 'About' section with information about the individual project for the Computational Creativity course at VUB 2020-2021. There is also a 'Releases' section indicating no releases published and a 'Packages' section indicating no packages published. A 'Languages' chart shows C++ at 86.1%, Python at 9.1%, Jupyter Notebook at 2.7%, PostScript at 1.0%, TeX at 0.5%, and HTML at 0.3%.



Getting your opinions

- Custom PHP evaluation tool
- 25+ entries
- Check for human bias
- 12 images
- Rate GANSpace modification
- Rate direct StyleGAN2 output
- ... Did you participate?

Rate these modified car designs



Correspondence 1 (-) 2 3 4 5 (+)
An image is considered of good correspondence (5) if the cars displayed in the row "start" are clearly recognizable in the variants displayed below and modifications performed are similar between all four cars.

Realism 1 (-) 2 3 4 5 (+)
An image is considered very realistic (5) if you wouldn't doubt it could be an image you'd see in a car magazine.

Creativity 1 (-) 2 3 4 5 (+)
Whether you find the image/modifications creative is a subjective manner; if you recognize elements off existing cars please leave them in the notes section.

Made by Human Computer
Whether you think the modifications are made by a human or a computer.

Notes

This field can be used to discuss recognized cars, what you think the performed modification is, reasoning for exceptionally low or high score and more.



Link to survey: <http://car-design-survey.lennertbontinck.com/>

Interesting thus far!

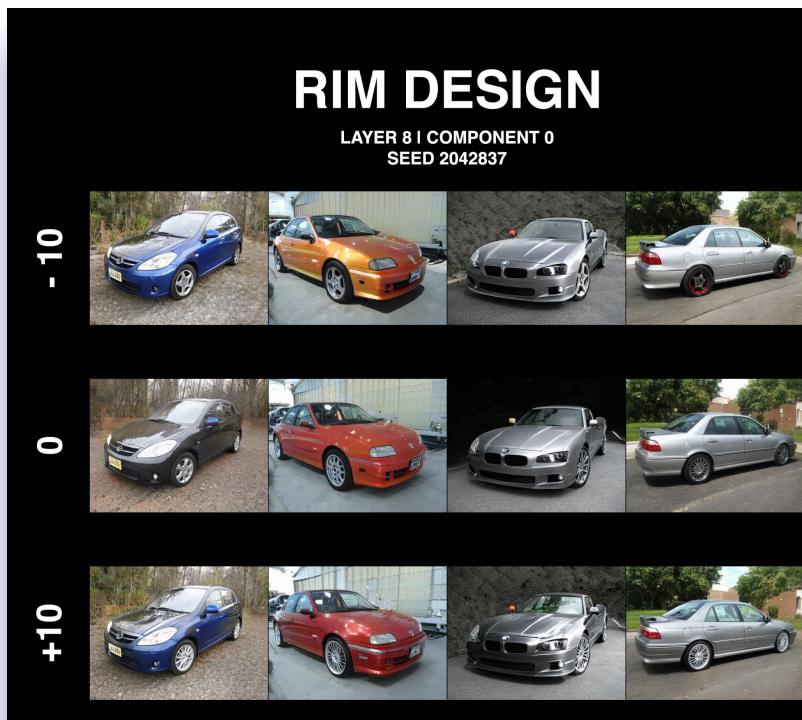
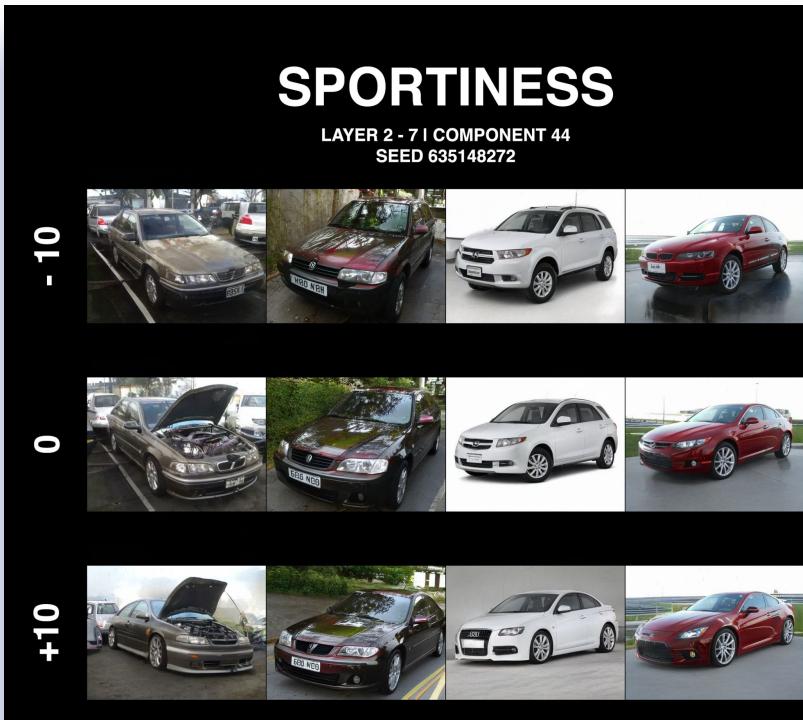
- People acknowledge bias
- Impressed by results
- Positive feedback by enthusiasts
- Promising results thus far
- ... But more analysis still needed

```
participant_id,image_id,carlike,detail,realism,resemblence,creative,general_impression,note
1,5,1,1,1,1,3,1,computer,"unique but not a car"
1,6,5,4,3,3,4,2,known,"Hmmm not sure if that is two fronts haha"
1,7,5,5,5,5,4,4,known,
1,8,5,4,3,3,4,2,computer,
1,9,5,4,3,3,4,2,computer,
1,10,5,4,4,5,4,4,known,
1,11,5,4,3,4,4,4,computer,
1,12,2,4,1,4,5,1,known,"this one is quite cool and reminds me of a mini"
2,5,2,1,1,1,4,4,computer,"look nothing like a car but I quite like it. It looks like a albums cover of some horror music."
2,6,3,5,3,2,4,3,known,"Audi looks. Lots of details for a car that has two fronts lol"
2,7,5,4,5,2,4,3,known,"I love an old Ford pic from the 70's. Reminds me of the something odd with the doors"
2,8,4,3,4,4,3,3,human,"reminds me of a racing car with the mirror, looks like a modern SUV front with classic BMW headlights"
2,9,4,3,3,4,5,3,known,"The car is not creative but the text is cool. not easy to determine front and one of the doors is actually inside the body"
2,10,5,5,3,3,4,4,known,"Quite like this image, feels like a car brochure, something odd with the reflection and no clue what the fog in the back"
2,11,4,1,3,4,2,2,computer,"Looks realistic, but also not at all (if that makes sense). Reminds me of those Alpinas"
2,12,4,4,2,2,5,4,human,"I actually quite like this image. If you look at it quickly it doesn't look as if anything is wrong yet so much is. Its re
```



Link to survey: <http://car-design-survey.lennertbontinck.com/>

Some more examples



Some more examples



Conclusion



- Accomplished my (creative) aims
- External evaluation analysis needs further work
- Interesting future extensions
- Convinced GANs will play an important role in CC
- ... But remember:

“By far, the greatest danger of Artificial Intelligence is that people conclude too early that they understand it.”

- Eliezer Yudkowsky

The screenshot shows a GitHub repository page for a project titled "Computational Creativity project". The repository has 1 branch and 0 tags. It contains 63 commits from user "ea71812" over the last 14 days. The commits are listed as follows:

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The page also features a "Table of contents" sidebar with links to "Student info", "Finished assignments", "Presentations", "GANSpace tool", "Evaluation tool", and "Generated images". A "Languages" section at the bottom shows the distribution of code: C++ (86.1%), Python (9.1%), Jupyter Notebook (2.7%), PostScript (1.0%), TeX (0.5%), HTML (0.3%), and Other (0.3%).



Questions about Computer generated car design?

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