

CAN MACHINES BE CREATIVE?

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CAN MACHINES BE CREATIVE?

ML can play chess, Go, recognise pictures

We have seen machine generated art, *but*

Do machines merely generate or can they be creative?

Many people find it hard to think of machines being creative...

‘There’s a difference between “impossible” and “hard to imagine”. One is about *it* the other is about *you!*’ – Marvin Minsky (1985)

IF MACHINES ACTUALLY WERE CREATIVE...

Why does this make people uncomfortable?

Creatives

“My creativity is special”

Non-creatives

“Creativity is akin to genius – only special people have the ability”

Both ideas mistakenly believe creativity to be a special ability afforded to the lucky few

Creativity ≠ Talent

“Creativity is merely an aspect of intelligence” (Boden, 2004)

CREATIVITY

Standard definition of creativity (Runco & Jaeger 2012)

“Creativity requires both originality and effectiveness”

“The use of imagination or original ideas to create something; inventiveness” (Oxford English Dictionary)

“Creativity needs creativity to explain itself.” (Still & Inverno, 2016)

Over 100 definitions – none of which depend on an aesthetic domain

There are 2 types of Creativity (Boden, 2009):

Psychological (P) Creativity

Historical (H) Creativity

Colloquially people tend to focus on H – computationally we are *only* interested in P

COMPUTATIONAL CREATIVITY

'The philosophy, science and engineering of computational systems which, by taking on particular responsibilities, exhibit behaviours that unbiased observers would deem to be creative' (Colton & Wiggins, 2012)

Three ways that computers can display creativity(Boden04)

Combination of new ideas

Exploration of the limits of conceptual space

Transformation of established ideas that enable the emergence of unknown ideas



**Mere
Generation**

**Computational
Creativity**

ML FOR CREATIVITY

What problems to tackle?

Not limited to aesthetic problems

Logic, problem solving, scientific, real-world problems would benefit from creative solutions

Not all systems are based on generating 'a thing' within one domain - Concept, analogy, blending

Adaptive Systems – creativity emerges through behaviours within a domain but may not be dependent on said domain

Generally start by picking a domain....

APPLYING ML TO CREATIVITY

Problem: Creativity

->: Music

->: Audio music

->: Music composition

->: Tonal music

->: Single melody line construction

->: Key sig, time sig, length...

->: #notes, organisation, phrase matching,

->: *'Twinkle twinkle little star'*

When did we lose the creativity?

SEARCHING FOR CREATIVITY

**Need to constrain the space to define the problem/
representation**

**Simultaneously need to remain flexible and broad enough to
search and transform**

ML approach

- Creativity is ill-defined
- Often the ideal result requires a subjective measure
- ML based around objectives
- Can we enumerate a subjective value?

EC approach

- Define problem (domain/concept space)
- Define representation
- Define fitness measure

EC FOR CREATIVE TASKS

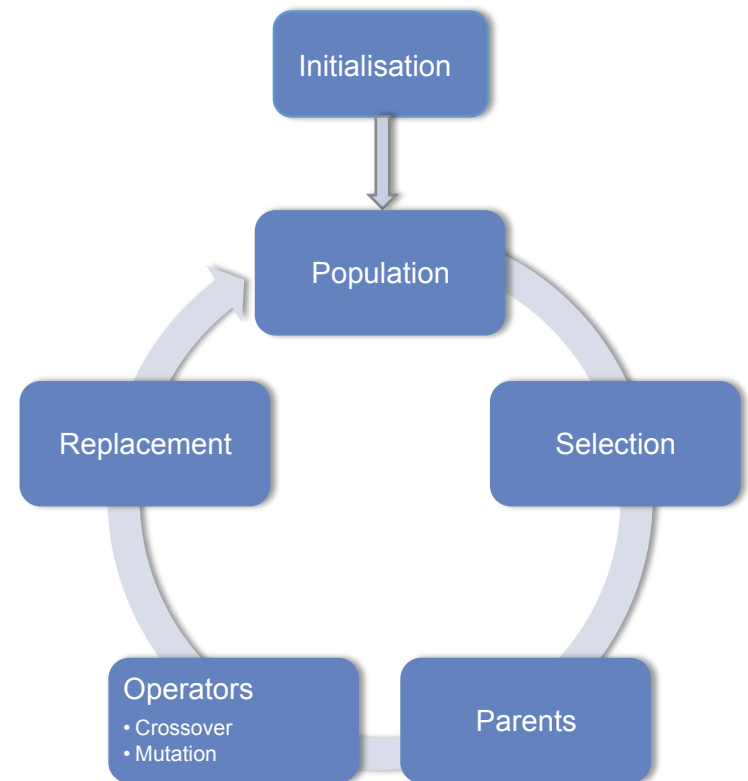
Evolution works on a population of solutions

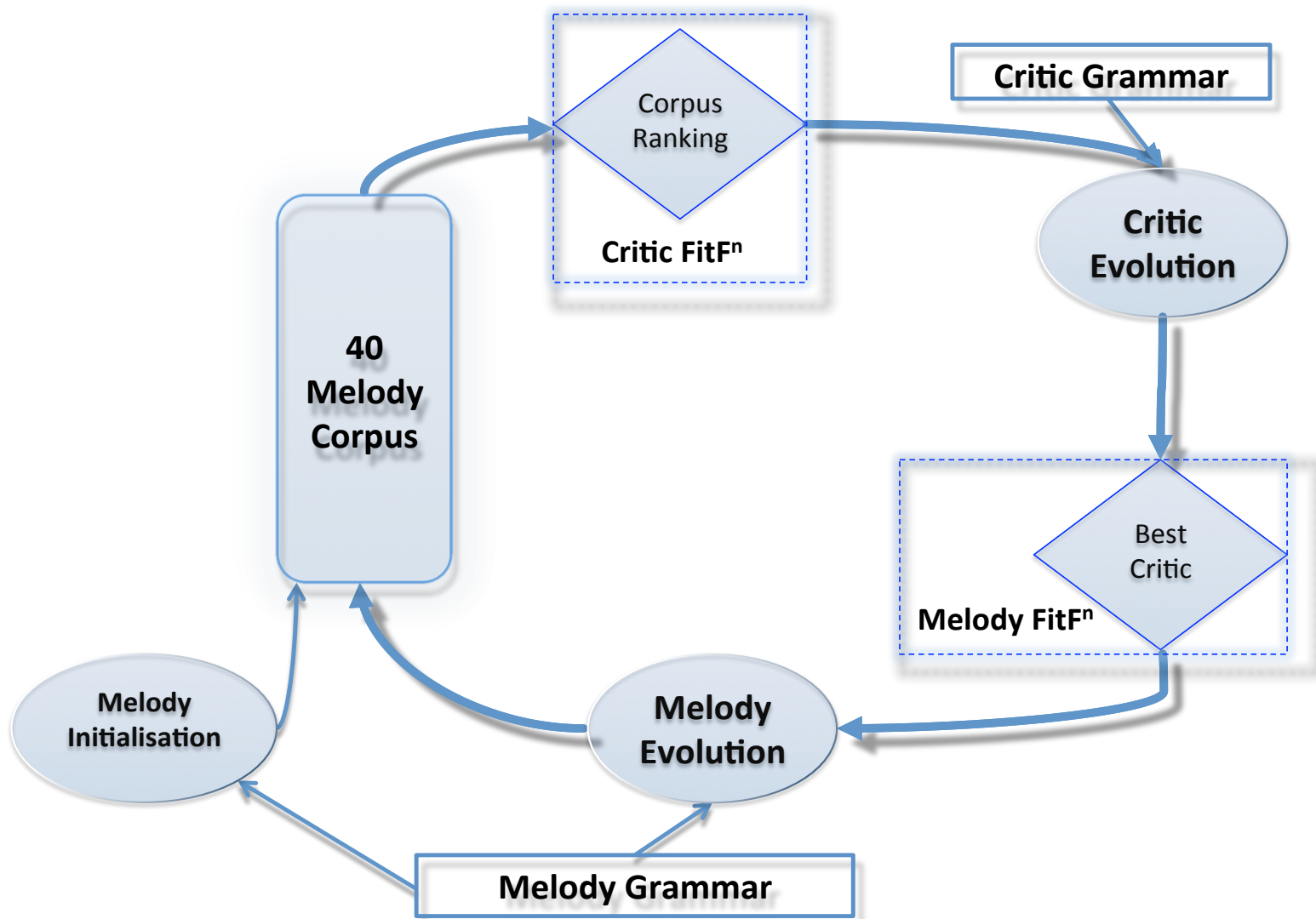
The fitness goal can be relative rather than based on specific pre-defined error

System can be designed to have an emergent fitness measure

Grammar based systems (GP, GE)

-transformations





'The Popular Critic' Loughran & O'Neill 2016

EVALUATION

Fitness vs. evaluation

Internal vs. external

What to evaluate

The system, music, method, creativeness?

How to evaluate creativity?

Creative Tripod: (Colton, 2012)

SPECS (Jordanous, 2012)

Evaluate method along with output – not a new phenomenon

Human-driven style tests

MDtT, MOtT (Turing-esque tests) (Ariza, 2009)

Crowd Sourcing

- Online?
- Concert hall?

Is human opinion necessary or even appropriate?

LOVELACE TEST

Lovelace Questions:

- Can computational ideas help us understand human creativity?
- Can computers ever do things that appear creative?
- Can computers ever recognise creativity?
- Can computers ever *really* be creative?

Lovelace test

- Agent **A**, output **o** human architect **H**
- If **H** cannot explain how **A** produced **o** -> test passed. (Bringsjord)

Would a programming mistake pass this? If not why not? Is human inspiration not akin to a mistake?

You must know what your system was supposed to do, before evaluating.

Does the assumption of using human opinion limit the capabilities of systems that we may not have even considered yet? (Loughran & O'Neill 2017)

CONCLUSION

We need to avoid the comforting notion that creativity is limited to humans

Creativity is not the same as talent

Creative applications are not limited to aesthetic applications

Evolutionary computation is an excellent place to start

Evaluation is important – but don't limit it through assumptions

'Science is not about building a body of known 'facts'. It is a method for asking awkward questions and subjecting them to a reality-check, thus avoiding the human tendency to believe whatever makes us feel good'

(Pratchett, SoD)

BIBLIOGRAPHY

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Minsky, M.L. (1982) : Why people think computers can't. *AI Magazine* 3(4), 3

Boden, M.A. (2004): *The creative mind: Myths and mechanisms*. Psychology Press

Boden, M.A. (2009) : *Computer models of creativity*. *AI Magazine* 30 23

Runco, M. A., and Jaeger, G. J. (2012): The standard definition of creativity. *Creativity Research Journal* 24(1):92–96.

Oxford English Dictionary: <https://en.oxforddictionaries.com/definition/creativity>

Still, A., and d'Inverno, M. (2016). A history of creativity for future AI research. In *ICCC 2016*. Universite Pierre et Marie Curie .

Loughran, R., O'Neill, M. (2016): The popular critic: Evolving melodies with popularity driven fitness. In: *Musical Metacreation (MuMe)*, Paris.

Colton, S., Wiggins, G.A., et al. (2012): Computational creativity: the final frontier? In: *ECAI*. Volume 12. 21{26}

Colton, S. (2012) : The painting fool: Stories from building an automated painter. In: *Computers and creativity*. Springer 3{38}

Jorrdanous, A. (2012): A standardised procedure for evaluating creative systems: Computational creativity evaluation based on what it is to be creative. *Cognitive Computation* 4 246{279}

Ariza, C. (2009). The interrogator as critic: The Turing test and the evaluation of generative music systems. *Computer Music Journal* , 33 (2), 48–70.

Bringsjord, S., Bello, P. & Ferrucci, D. (2001). Creativity, the Turing test, and the (better) Lovelace test. *Minds and Machines* , 11 (1), 3-27.

Loughran, R., O'Neill, M. (2017) : Limitations from assumptions in generative music evaluation. *Journal of Creative Music Systems* 2(1)

Pratchett, T. , Cohen, J. Stewart, I. (1999) : *The Science of the DiscWorld*