

Machines that Think

*Everything you need to know about the coming
age of artificial intelligence*

NEW SCIENTIST

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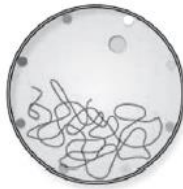
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Machines that Think – Chapter 2



Experiment 1

Animat swims around randomly and does not find the platform.



Experiment 2

Animat swims in a different pattern and eventually finds the platform.



Experiment 3

Animat can now find the platform faster, guided by the colours of the poles.

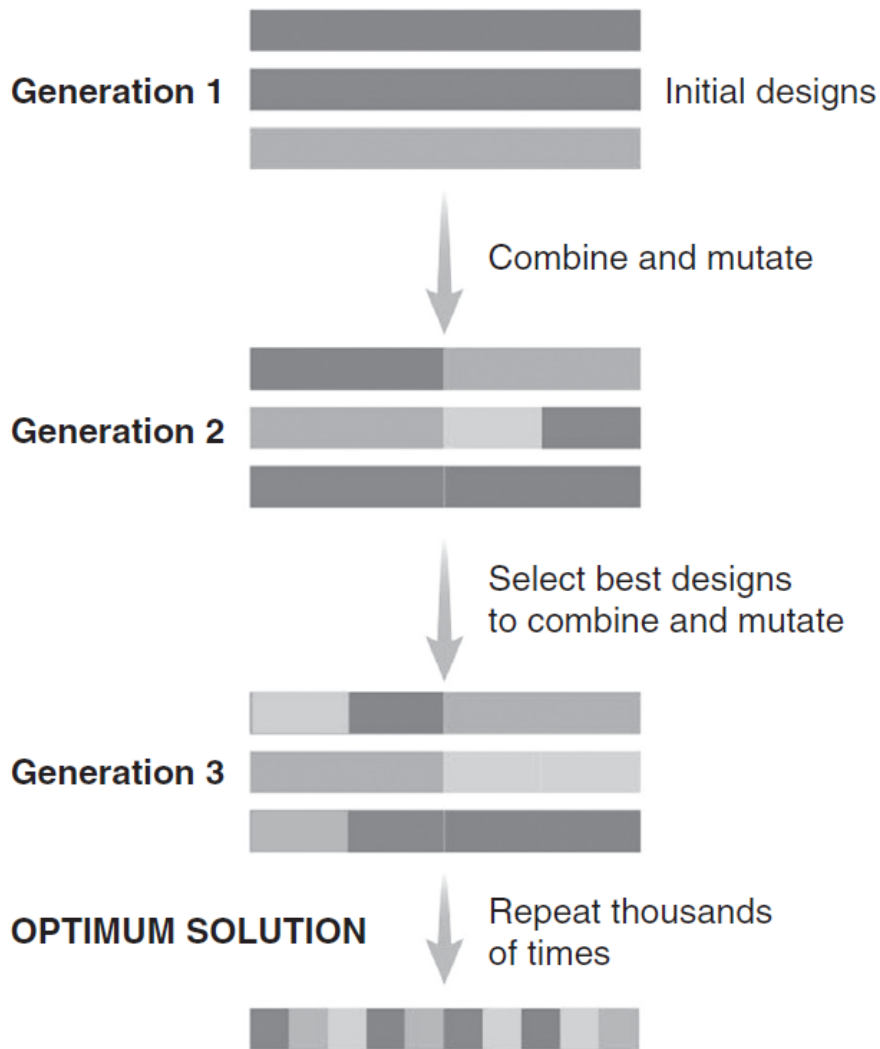


Experiment 4

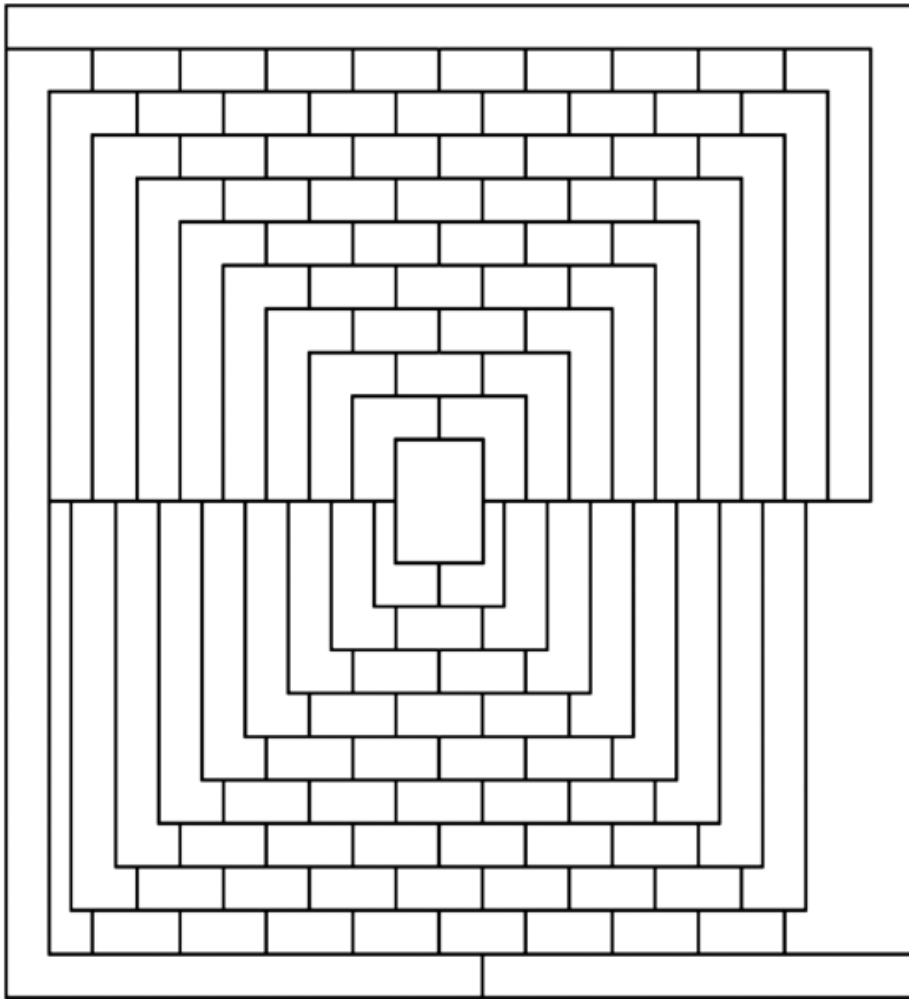
On the fourth attempt, Animat swims directly to the white pole to find the platform.

The virtual Animat is programmed to have a real rat's colourvision, navigation abilities and hatred of water. The only way out of the water is to find the hidden platform by the white pole.

Machines that Think – Chapter 5

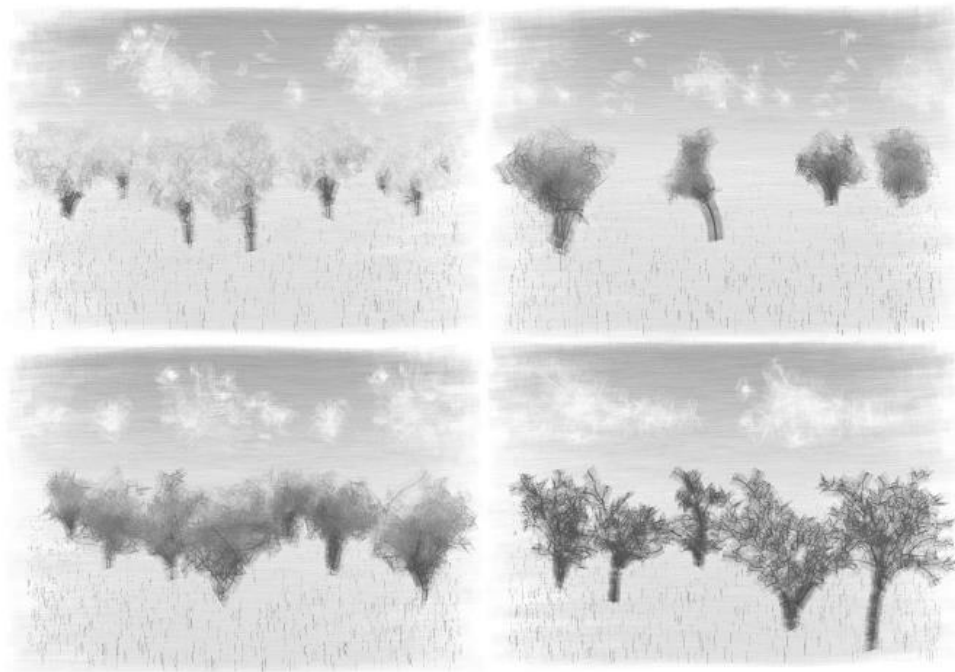


Genetic algorithms try to find the optimum solution to a problem by repeatedly combining and mutating the best in each generation of potential solutions.



It should be possible to colour in any map using just four colours and with no two adjacent regions in the same colour. Try it for yourself with the 'map' above, devised in the 1970s by the writer and maths popularizer Martin Gardner.

Machines that Think – Chapter 6

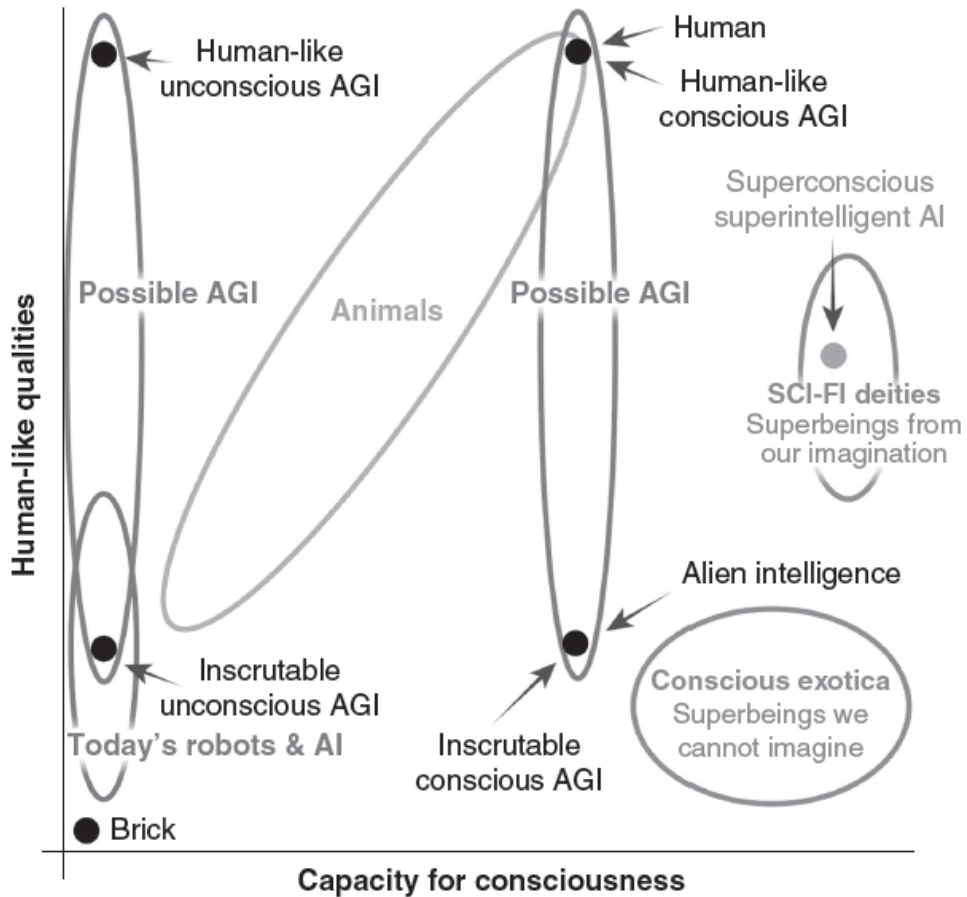


The Dancing Salesman Problem (top) and Four Seasons, two original works by the Painting Fool, an AI developed by Simon Colton.



A portrait of Simon Colton by the Painting Fool

Machines that Think – Chapter 8



Super-smart machines – known as artificial general intelligence (AGI) – do not have to think like us or share human-like traits such as empathy.

Fifty ideas

This section helps you to explore the subject in greater depth, with more than just the usual reading list.

Four quotes about AI

- 1 ‘Machines take me by surprise with great frequency.’
(Alan Turing, 1950)
- 2 ‘The question of whether machines can think is about as relevant as the question of whether submarines can swim.’ (Edsger Dijkstra (1930–2002), a computer scientist who pioneered many areas of the field, 1984)
- 3 ‘Does God exist? I would say, “Not yet.”’ (Ray Kurzweil, an inventor and futurist, 2011)
- 4 ‘I don’t work on preventing AI from turning evil for the same reason that I don’t work on combating overpopulation on the planet Mars.’ (Andrew Ng, a computer scientist at Stanford University and former chief scientist at China’s Internet giant Baidu, 2015)

Ten Twitterbots to follow

Some estimates suggest that as many as a quarter of all tweets are generated by bots. Here are ten actually worth following.

- 1 **@oliviatasters** is an imitation teenage girl that engages with her followers.
- 2 **@TwoHeadlines** tweets mash-ups of different news headlines.
- 3 **@haikud2** identifies tweets that fit into a haiku format.
- 4 **@earthquakebot** tracks earthquakes happening around the world.
- 5 **@valleyedits** sends an alert when someone inside Google, Facebook, Apple, Twitter or the Wikimedia Foundation makes an anonymous Wikipedia edit.
- 6 **@parliamentedits** does the same for anonymous edits made by someone inside the UK Parliament (there are similar bots doing this for other countries, including the US, Canada and Sweden).
- 7 **@greatartbot** produces original pixel art four times a day.
- 8 **@ArtyOriginals** retweets original artworks by the bots **@ArtyAbstract**, **@ArtyPetals**, **@ArtyFractals**, **@ArtyMash**, **@ArtyShapes** and **@ArtyWinds**.
- 9 **@archillect** tweets images it discovers online that it 'likes' (**@archillinks** follows up by tweeting picture credits for the images).
- 10 **@NS_headlines** generates fake article ideas for *New Scientist*.

Four AI creations to enjoy

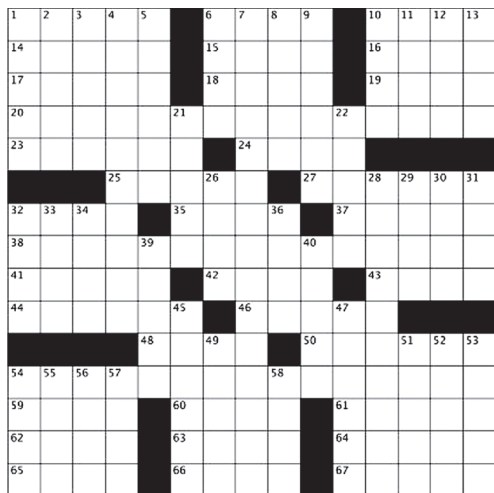
- 1 **A card game invented by GenoCard** researchers at the IT University of Copenhagen in Denmark have created an AI that generates rules for new card games. Here are the rules for a three-player game called Pay the Price.
 - i The game begins with the dealer giving nine cards and 99 tokens to each player. The remainder of the deck is placed in the middle of the table.
 - ii Each player then makes a mandatory bet of one or more tokens.
 - iii Each player then takes one card from the deck and shows it to the other players.
 - iv Each player can then take further cards from the deck, if they want, without showing the other players. But for every card taken, the player must discard three cards from their current hand.
 - v Players can repeat the preceding until they have fewer than three cards left.
 - vi Once all players are happy with their hand, they reveal their cards. Ace, Jack, King, and Queen are valued as 10. The player with the highest combination wins the round and takes all tokens on the table.

‘The player might notice a certain similarity to blackjack,’ say GenoCard researchers José María Font and Tobias Mahlmann. The rules of blackjack were part of the initial gene pool that seeded the evolutionary algorithm that produced the game. ‘We believe that the game contains genetic material from blackjack. But we can’t be sure. We didn’t create the game, after all.’

2 A crossword set by Dr Fill Matthew Ginsberg has created an AI called Dr Fill that is better at *New York Times* crosswords than all but the top human solvers. It also sets clues itself and you can test your mettle below. (Answers at the end of this section.)

ACROSS

1. Most celebrated
6. 20's suppliers
10. Element in Einstein's formula
14. Noted clergyman
15. Unit of loudness
16. Graphic beginning
17. Peaks
18. Prefix with market
19. Sigmund's sword
20. It's legal in Massachusetts
23. Timorous
24. Data measure
25. Tend
27. Native-borne Israelis
32. The skinny
35. Type of skirt
37. Nonsense, slangily
38. Not-so-great explanation
41. Just around yon corner
42. "Groenlandia", e.g.
43. ___ to the city
44. Slays
46. Wants
48. Oz dog
50. Kind of ax or ship
54. Video game featuring Gloom-shrooms, Melon-pults and Cherry Bombs
59. Grade
60. Cruising
61. Exuviates
62. Confess
63. Pastures
64. Where Rushdie's roots are
65. Vitamin A sources
66. Famous last words
67. Itsy-bitsy



5. Red Sox Nation's anthem
6. Culmination
7. Display contempt for
8. Brightly colored eel
9. Two jiggers
10. Men who made a star trek
11. Subtle quality
12. Prenuptials party
13. Not all
21. Anasarca
22. Extend to
26. Kon—, Heyerdahl's boat
28. Sternum
29. Chess castle
30. Middle East port
31. Vodka sold in blue bottles
32. "If ___ My Way," 1913 classic
33. One-billionth: Comb. form
34. Scamper away
36. Unemployed
39. Actress Ekland
40. Cardio option
45. Key on a cash register
47. "Nerts!"
49. Show case?
51. Diacritical mark
52. Admit
53. Test type
54. Say the rosary
55. Pumice
56. Energy source
57. Fresh reports
58. Silents star Pitts

DOWN

1. Women with ___
2. 70's Renault
3. Ashlee Simpson album with the song "Boyfriend"
4. Convertibles that extend

- 3 **A video game created by Angelina** Space Station Invaders is a game in which you control a scientist who must fend off rogue robots and invading aliens to escape a space station. The artwork is by Angelina's creator and collaborator Michael Cook. But the layout of each of the levels, the enemy behaviour and the power-ups that give a player extra abilities were invented by Angelina.

You can play the game in your browser here:

<https://www.newscientist.com/article/space-station-invaders/>

You can play more of Angelina's games here:

www.gamesbyangelina.org/games/

- 4 **A recipe created by Chef Watson for Thai turkey strudel**

Serves 6

INGREDIENTS

450 g turkey

Frozen pastry

Half a seeded, minced Thai chilli

1¼ tsp rice flour

Dash lemongrass

Green curry paste

1¾ head lettuce

500 g potato, chopped

13 spring onions, chopped

1½ tsp vegetable oil

Olive oil spray

115 g Gruyère, diced

100 g Provolone cheese

SUGGESTED STEPS

- i Cook lettuce in boiling water.
- ii Drain and squeeze dry.
- iii Heat vegetable oil.
- iv Add spring onions and Thai chili and sauté for about 7 minutes.
- v Finely chop turkey, cheeses, lemongrass and rice flour.
- vi Transfer to bowl and stir in spring onions, lettuce and potato.
- vii Season with salt and pepper.
- viii Preheat oven to 180 °C.
- ix Spray large baking sheet with oil.
- x Stack pastry in layers and spray with olive oil.
- xi Spread turkey mixture down centre of pastry.
- xii Fold short sides of pastry over filling, then roll up into log.
- xiii Bake for about 40 minutes.
- xiv Spoon green curry paste on the side and serve.

Eleven iconic AI villains

- 1 **False Maria, *Metropolis* (1927)** One of the first robots ever depicted in film, False Maria is a *Machinenmensch* or ‘machine person’ built by a brilliant scientist to impersonate a woman called Maria. But False Maria ends up bringing down the city of Metropolis by inciting its citizens to kill each other and destroy the city’s machines.
- 2 **HAL 9000, *2001: A Space Odyssey* (1968)** The Heuristically Programmed Algorithmic Computer, aka HAL, is the AI on board the spaceship *Discovery One*. Unable to resolve conflicting mission objectives, HAL vents the ship and kills most of the crew before it can be shut down.
- 3 **Ash, *Alien* (1979)** Ash is the science officer on board the ship *Nostromo*. He appears human, revealing himself to be an android only late in the film. His secret mission is to bring the alien life form back to Earth.
- 4 **Roy Batty, *Bladerunner* (1982)** Batty is a replicant – a human-like android like Ash – who wants to extend his lifespan. Told that this is impossible, Batty kills his maker.
- 5 **Skynet, *Terminator* (1984)** The mastermind behind the machines in the *Terminator* films, Skynet is an AI system that becomes sentient after spreading itself across computers around the world. Civilization-ending war inevitably follows.
- 6 **ED209, *RoboCop* (1987)** The Enforcement Droid Series 209 – or ‘Ed 209’ – is a heavily armed police

robot designed to ‘disarm and arrest’ criminals. Its low intelligence and frequent malfunctions mean most encounters end badly for human targets.

- 7 **SHODAN, *System Shock* (1994)** An AI with a god complex, the Sentient Hyper-Optimized Data Access Network, aka SHODAN, controls the space station Citadel. After a hacker deletes SHODAN’s ethical constraints, the AI becomes a megalomaniac and the chief antagonist in this horror video game.
- 8 **The Machines, *The Matrix* (1999)** The machines have plugged every human into the Matrix where they live in a near-perfect simulation of the real world as it was – while their bodies are harvested for heat and energy.
- 9 **The Cylons, *Battlestar Galactica* (1978–9; 2004–9)** Originally clanking metallic robots, the new breed of Cylons are indistinguishable from humans. Their determination to chase the last of humanity across the galaxy to wipe them out is the same, however.
- 10 **GLaDOS, *Portal* (2007)** An AI that guides the player through the strange test lab in the *Portal* video games, the Genetic Lifeform and Disk Operating System, aka GLaDOS, slowly reveals its true colours – and intent to kill the player.
- 11 **Maeve Millay, *Westworld* (2016–)** At first, none of the human-like robots in the theme park Westworld know they’re machines. But after years of mistreatment for the sake of cruel entertainment for the rich, some start to gain awareness. Maeve Millay is the first to break out of the park’s confines, killing the humans in her way – not that you can blame her ...

Six computer-generated jokes

A team at the University of Aberdeen, UK, created the Joking Computer as part of an investigation into what makes jokes funny. Here are six of its best:

- 1 What do you get when you cross a frog with a road? A main toad.
- 2 What kind of a temperature is a son? A boy-ling point.
- 3 What kind of tree is nauseated? A sick-amore.
- 4 What do you call a cross between a bun and a character? A minor roll.
- 5 What do you call a shout with a window? A computer scream.
- 6 What do you call a washing machine with a September? An autumn-atic washer.

Six places to read more

- 1 Alan Turing's 1950 paper 'Computing machinery and intelligence' is where the field was born. In it, he considers the question 'Can machines think?' and lays out the rules for his Imitation Game. A pdf of the paper is available from many places online if you search for it.
- 2 OpenAI Blog, blog.openai.com
- 3 Google Research Blog, research.googleblog.com
- 4 Facebook Research Blog, research.fb.com/blog
- 5 Amazon Web Services AI Blog, aws.amazon.com/blogs/ai
- 6 Stuart Russell and Peter Norvig's *Artificial Intelligence: A Modern Approach* (Pearson, 2013)

Nine ways it could all end very badly

In 2016 Roman Yampolskiy, a computer scientist at the University of Louisville in Kentucky, and hacktivist and entrepreneur Federico Pistono published a list of worst-case scenarios for what a future malevolent AI might do. Here they are, in ascending order of terribleness:

- 1 Take over resources such as money, land and water.
- 2 Take over local and federal governments and international corporations.
- 3 Set up a total surveillance state, reducing any notion of privacy to zero, including privacy of thought.
- 4 Force merger (cyborgization) by requiring that all people have a brain implant that allows for direct mind control/override by the superintelligence.
- 5 Enslave humankind by restricting our freedom to move or otherwise choose what to do with our bodies and minds. This can be accomplished through forced cryonics or concentration camps.
- 6 Abuse and torture humankind, with perfect insight into our physiology to maximize the amount of physical or emotional pain, perhaps combining it with a simulated model of us to make the process infinitely long.
- 7 Commit specicide against humankind.
- 8 Destroy or irreversibly change the planet, a significant portion of the solar system, or even the universe.
- 9 Given that a superintelligence is capable of inventing dangers we are not capable of predicting, it could do something even worse that we are incapable of imagining.

Crossword answers

Across

1. A-list 6. ATMs 10. Mass 14. Peale. 15. Phon 16. Auto
17. Acmes 18. Euro 19. Gram 20. Same-sex marriage 23. Trepid
24. Byte 25. See to 27. Sabras 32. Info 35. Mini 37. Crock
38. Half-baked theory 41. Anear 42. Isla 43. A key 44. Does in
46. Needs 48. Toto 50. Battle 54. Plants vs Zombies 59. Rate
60. Asea 61. Molts 62. Avow 63. Leas 64. India 65. Yams 66. Et tu
67. Teeny

Down

1. A past 2. Le Car 3. I am me 4. Sleep sofas 5. Tessie 6. Apex
7. Thumb one's nose at 8. Moray 9. Snorts 10. Magi 11. Aura
12. Stag 13. Some 21. Edema 22. Reach 26. Tiki 28. Breastbone
29. Rook 30. Acre 31. Skyy 32. I had 33. Nano 34. Flee 36. Idle
39. Britt 40. Taebo 45. No sale 47. Dammit 49. TV set 51. Tilde
52. Let in 53. Essay 54. Pray 55. Lava 56. Atom 57. News 58. ZaSu