

## INDEX

Locators in *italics* refer to diagrams and figures; ‘artificial intelligence’ in subheadings is abbreviated to AI; as most of the text is about the United States there is no separate entry term for this.

1-2-4 problem (China) 219

3D microchips 73

3D printing 171–5

3D vision 3–5, 24

adaptive learning systems 147–8

ageing population 161–5, 215–18

AGI *see* Artificial General Intelligence (AGI)

agriculture, automation ix, 23–7

“AI winters” 227, 228

aircraft

automation and pilot skills 253, 255

development 52–3, 54, 55, 68, 69, 69n, 173

drones 122, 173

Alaska, citizen’s dividend 267

algorithmic programmes 86–7, 127, 128

algorithms

analytical skills xv, 97–8, 102–3, 121, 126, 127, 131

artificial neural networks 93–4, 115, 123, 155

automated trading 58, 115

big data analysis 89–91, 95–6

creativity 110–17

development 73

use of genetic programming 111, 112

machine marking 134, 135

in translation 92

alien invasion parable 188–90

“All Can Be Lost: The Risk of Putting Our Knowledge in the Hands of Machines” 252

Amazon

cloud facilities 106–7

distribution and delivery 17, 184n

financial success 79

interest in AI 227–8

“Mechanical Turk” service 128n

Android devices 22, 81, 123–4

Apple technology 20, 79, 94

Arai, Noriko xv

art, computer created 114–15

Artificial General Intelligence

concerns 234–7

scenarios 227–9, 230–2, 232–6  
 Singularity 229–34  
 artificial intelligence  
   *see also* algorithms; Artificial General Intelligence; machine intelligence; robots  
   analytical skills xv, 97–8, 102–3, 121, 126, 127, 131  
   creativity 110–17  
   narrow AI 225–6  
 artificial neural networks 93–4, 115, 123, 155  
 Australia, agriculture x–xi, 25  
 Australian Centre for Field Robotics (ACFR) 25  
 automated invention machines 112  
 automated trading algorithms 58, 115  
 automation  
   *see also* algorithms; information technology; robotics; robots  
   agriculture ix, 23–7  
   anti-automation view 252–6  
   in China 10–11, 221  
   cloud computing 21–3, 54, 106–9, 112, 130  
   distribution centres 17–18, 184n  
   economists' views 61–2, 131  
   and employment 9–10, 19–20, 27, 52, 53, 54, 80, 96–7, 107–10  
   health care 158–60, 167  
   human-machine synthesis 124–9, 230–1  
   job loss 27, 50–1, 80, 96–7, 107–10  
   knowledge-based occupations 87–8, 95–6, 97–8, 107–8, 208  
   machine marking 133–6  
   manufacturing 2–3, 5–6, 8–10, 10–12, 56, 173–4, 221  
   and outsourcing (offshoring) 61, 66, 108, 117–24, 148  
   predictions of effects 30–3, 61, 218, 248  
   and productivity 33, 34, 53, 54, 56, 78, 210–11  
   risks 254–5  
   service industry 12–21  
   of specialised tasks 75  
   white-collar jobs xv, 50–1, 80, 87–8, 96–7, 106, 107–8  
 autonomous cars xiii–xiv, 96, 175–86  
 Autor, David 51  
*Average is Over* (Cowen) 126, 129n  
 aviation *see* aircraft  
  
 banking 42n, 48, 57, 59, 61, 105, 115, 117  
 Barrat, James 227, 234–5  
 basic income guarantee 256–63, 266–71  
 Baxter (multifunctional robot) 5–6, 7  
 benefits (welfare) 217–18, 219, 258  
   *see also* basic income guarantee  
 Bernanke, Ben 39

big data xv, 88–91, 95–6, 96–8, 164–5  
*Big Switch, The* (Carr) 75  
 bio-printing 174  
 Blockbuster 17, 19–20  
 Boeing 173  
 Boston Consulting Group 10  
 Bowley's Law 39–40  
 brain 1–2, 74  
     intellect augmentation 230–1  
     simulation 233–4  
 Brin, Sergey 180–1, 182, 232  
 Brint, Steven 250  
 Brooks, Rodney 5  
 Brynjolgfsson, E. 61–2, 124–5, 253  
 “busy child scenario” 234–5  
  
*Capital in the Twenty-First Century* (Piketty) 273–4  
 capitalism 254, 272–4  
     *see also* market economies  
 car industry  
     autonomous cars xiii–xiv, 96, 175–86  
     job loss 184, 185–6  
     nanotechnology future 242  
     robotics 3  
 carbon nanotubes 73n, 241  
 Carr, Nicholas 75, 252  
 Central Intelligence Agency (CIA), data analysis 87  
 cheating, online courses 141  
 Cheney, Dick 236  
 chess competitions 99–100, 125, 126  
 China  
     automation and job loss 10–11, 221  
     consumer demand 56, 218–22  
     intelligent gene research 232n  
     labour's share of income 41–2  
     market for robots 3  
     overeducation 123, 126, 249  
 Chomsky, Noam 232–3  
 Citigroup 192–3  
 citizen's dividend 256–63, 266–71  
 climate change 271, 282–4  
 cloud computing 21–3, 54, 106–9, 112, 130  
 cloud robotics 21–3  
 cognitive computing chip (IBM) 74  
*Collapse* (Diamond) x–xi

college graduates *see* graduates  
collision avoidance systems (cars) 179  
Colton, Simon 114–15  
communication, automated 95–6  
comparative advantage 76–7  
compensation *see* wages  
competency-based credentials 140, 142–3, 148  
computer hardware 71–3, 74  
computers *see* algorithms; Artificial General Intelligence; artificial intelligence; automation;  
information technology  
construction industry 175  
consumer spending  
and basic income guarantee 264, 268  
China 219–20  
and demand 190–1, 192, 201–3, 222–3  
nontradable services 56  
and permanent income hypothesis 198n, 205  
effect of recession 195–6  
wealthy sector xvii, 192–3, 194, 195, 207–8  
workers as consumers 187–8, 191, 206, 208, 209, 217  
corporations  
algorithmic data analysis 91, 95  
income distribution and profits 40, 41–2, 57, 78–9, 197  
interest in AI 117–18  
Coursera 137, 141  
Cowan, Tyler 67  
Creative Machines Lab 110–12  
creativity, in AI 110–17  
credential inflation 250  
Crichton, Michael 240  
crime prediction, algorithmic 89  
Crossrail project 273  
Cyberdyne 163  
  
Darci software 115  
DARPA (Defense Advanced Research Projects Agency) 83, 175–6  
data analysis 88–91, 95–6, 96–8  
debt 129, 209, 212, 214  
Deep Blue computer 99–100  
deep learning 94–5, 96, 123  
deficit, UK 198, 199  
deflation 211–12  
delivery services 17, 184, 184n, 185  
Delta Electronics 11  
demand, consumers 190–1, 192, 201–3, 222–3

deskilling 49, 203–4  
 developing countries  
     effect of climate change 284  
     effect of technology 10–11, 25–6, 81, 222, 284  
 diabetes monitoring 166  
 “digital divide” 80  
 distribution, automation 17–18, 184n  
 document analysis software 127  
 downward mobility 209  
 Drexler, K. Eric 237–8, 239, 240–1, 242, 243–4  
 driverless vehicles xiii–xiv, 96, 175–86  
 drones 122, 173  
 dystopian future, literature and film 32, 215, 240  
  
 e-Discovery software 127  
 earnings *see* wages  
 eBay, delivery 17  
 economic growth  
     and income inequality 197–200, 207–10  
     and technology 49–50, 52–5, 67, 188–90, 210–11, 213  
 economic mobility, decrease 47, 209  
 Economic Policy Institute 130, 164  
 economic reform 256–78  
 economic trends 34–52, 67  
 economics  
     mathematical approach x, 199–200  
     traditional wages/productivity view 36–8, 36, 37, 38–9  
 economists  
     Bowley’s Law 39–40  
     dystopian view 215  
     on economic growth 67, 197–9  
     on job market polarization 50–1, 51–2  
     labor’s share of income study 41–2  
     view of automation 61–2, 131  
 economy  
     *see also* consumer spending; economic growth  
     and ageing population 215–18  
     basic income guarantee 256–63, 265, 266–71  
     capitalist solutions 272–4  
     definition 264n  
     and educational opportunities 261–2  
     feedback effects 200–7  
     financial crises 194–5, 200, 207, 214  
     and higher education 247–52  
     inflation and deflation 39n, 210, 211–12  
     effect of nanotechnology 243

plutocracies 214–15  
 public infrastructure investment 274–5  
 tax solutions 275–7  
 trends xvii, 34–52, 67, 215–18  
 workers as consumers 187–8, 191, 206, 208, 209, 217  
 education 247–50, 261–2, 262–3  
   *see also* graduates; higher education  
 educational robots 7  
 edX 137, 142  
 elderly 161–5, 217–18  
 electric cars 182  
 electronic offshoring 61, 66, 108, 117–24, 148  
*Elysium* (film) 215  
 email spam filters 91  
 employment  
   *see also* job creation; job loss; jobs market; unemployment  
   effects of automation 9–10, 19–20, 27, 52, 53, 54, 80, 96–7, 107–10  
   fast food industry 13–16, 204–5, 279  
   graduates 49–50, 130, 249  
   human-machine collaboration 126  
   Internet companies xvi, 78, 169  
   manufacturing jobs 3, ix, 9–10, 54, 56, 174  
   effect of nanotechnology 241, 242  
   retail industry 16–21  
   in super-intelligent machine era 236  
 engineering jobs 130, 250  
*Engines of Creation* (Drexler) 238, 240  
 environmental taxes 271  
 Eurega software 110–11  
 examination marking, automated machines 133–6  
  
*Fabricated: The New World of 3D Printing* (Lipson) 174  
 Facebook xvi, 94, 108, 169, 227–8  
 factory jobs 3, 8–10, 10–12, 54, 56, 174, 221  
 factory reshoring 8–12  
*Fantastic Voyage* (Kurzweil and Grossman) 231  
 farming ix, 23–7  
 fast food industry 12–15, 16, 204–5, 279  
*Fast Food Nation* (Schlosser) 204  
 feedback effects, economy 200–7  
 Ferrucci, David 101–2, 104n, 117  
 Feynman, Richard 137  
 finance sector 42n, 48, 57–8, 59, 61, 105, 115, 117  
 financial crises 194–5, 200, 207, 214  
   *see also* Great Recession

financial elite 46, 48–9, 61, 83, 207–8, 273–4  
  *see also* high income groups  
financialization 42n, 57–8  
fiscal policies 213–14  
fishing industry 24, 81  
food industry 12–16, 174–5, 204–5, 279  
Ford, Henry (II) 187  
Ford Motor Company 78, 187–8  
Foxconn 11, 11–12, 15  
fractional reserve banking 213n  
freestyle chess 125  
Frey, C.B. 218  
Friedman, Milton ix, 205  
FutureLearn 138, 143, 249

GDP, corporate profit percentage 40, 41, 57  
GDP deflator 37, 39n  
gene research 232n  
General Electric 160, 173  
General Motors 78  
*General Theory of Employment, Interest and Money, The* (Keynes) 200  
globalization 55–6  
  *see also* outsourcing  
“Goggles” feature 22–3  
Goldman Sachs 57  
Google  
  Android devices 22, 81, 123–4  
  automised communication 95–6  
  autonomous cars xiv, 96, 176–7, 178–9, 180–1, 182, 184  
  Calico project 232  
  cloud facilities 106  
  cloud robotics 21–2, 22–3  
  data handling 88–9  
  employees xvi, 78  
  financial success 79  
  interest in AI 227–8, 230  
  medical applications 166  
  translation tool 92, 123–4  
governments  
  interest in AI 228  
  policy influences 48, 59, 61  
graduates  
  income level 208  
  law 127–8  
  literacy skills 88

- medical AI system operators 157–8
- online course take up 138
- pharmacists 167
- skilled job loss xv, 49, 87–8, 121, 123–4, 129–31, 135, 148, 167, 203–4, 251
- underemployment 49–50, 130, 157–8, 249, 250, 282
- grapheme 73n, 244
- “gray goo” scenario 240, 243
- Great Recession
  - and fast food industry 14
  - job market polarization 52
  - joblessness 34, 44–5, 45, 54
  - and productivity 202
  - recovery 41, 194–5, 207–8
- “Great Reversal in the Demand for Skill and Cognitive Tasks” 130
- “Great Society” 257
- Great Stagnation, The* 67
- grey *see* gray
- Gross Domestic Product *see* GDP
- guaranteed income 256–63, 266–71
  
- Harvard University 137, 142
- Hawking, Stephen 225, 229
- Hayek, Friedrich 256–9
- health care
  - AI in diagnosis and treatment 104, 105, 153–9, 166–7
  - bio-printing and transplants 174
  - data use 165–6
  - elderly care 161–5
  - free healthcare 277–8
  - robotics 159–64
- high income groups
  - see also* financial elite
  - consumer spending xvii, 192–3, 194, 195
  - income gains during recession 40, 46
  - job loss 208
  - taxation 271
- high-skilled jobs
  - see also* graduates
  - potential outsourcing 121, 123–4
  - reduction 130–1, 251
- higher education
  - see also* graduates
  - and economy 247–52
  - machine marking 133–6
  - online courses 136–49
  - qualifications 140, 142–3, 147, 148, 249, 250



- student loans 129, 209
- horticulture, automation 24–5
- hours of work 281
- House* (TV programme) 151–2
- house construction, using 3D printing 175
- household income
  - see also* income inequality; low-income jobs
  - budgeting for essentials 211
  - growth in median incomes 35
- housework, and robotics 22
- “How Did Economists Get It So Wrong?” 200
- human analytical skills, algorithmic emulation 97–8, 102–3, 121, 127, 131
- human-machine symbiosis 124–9, 230–1
- Humvee (autonomous car) 175, 176
- Hybrid Assistive Limb (HAL) 162–3
  
- Iamus, music creation 113–14
- IBM
  - cognitive computing chip 74
  - development of Watson 98–106
- identity verification, online courses 140–1, 141–2
- immigration 119, 269
- immortality, speculation 231
- In Our Hands* (Murray) 261
- In-Q-Tel 87
- incentives to work 260–1, 278
- income distribution
  - basic income guarantee 256–63
  - labor vs corporate share 39–43, 40, 57, 78–9, 197
  - to wealthy sector 208
- income inequality
  - see also* low-income jobs
  - basic income guarantee 256–63
  - and consumer spending 192–6
  - development and growth xii, 34, 46–9
  - and economic growth 197–200, 207–10
  - industrialized nations 47, 47, 48
  - in super-intelligent machine era 236
  - and wealth taxation 273–4
- India
  - potential employees 123, 126
  - virtual environment workers 118
- Industrial Perception, Inc. 2, 3, 5
- industrial robots, use 2–3, 5–6
- inflation

- and basic income guarantee 268–9
- and wage/productivity ratio 39n, 211–12
- information professions *see* knowledge-based occupations
- information technology
  - see also* algorithms; automation; robotics; robots
  - acceleration xiii, 53–4, 66, 70–1, 72–5
    - see also* Moore’s Law
  - cloud computing 21–3, 54, 106–9, 112, 130
  - deskilling 49, 203–4
  - future impact 60–2
  - impact on employment 52, 53, 54
  - impact on finance sector 58
  - Internet businesses 78–81, 79
  - investment following recession 41
  - research funding 83
- innovation
  - see also* S-shaped curve
  - and consumer markets 222–3
  - driver in technology 52–3, 65, 66, 67, 68–70, 71
- intelligence, augmentation through implants 230–1
- intelligence agencies, interest in AI 228
- Internet
  - see also* online courses
  - business opportunities 78–81
  - and cloud computing 21–3, 54, 106–9, 112, 130
  - contribution to technological advance 66
  - data 88–9
  - recommendations to customers 91
  - workforce 169
- inventions, by genetically programmed algorithms 112–13
  
- Japan 25, 48, 131, 161, 216
- Jefferson, Thomas 257n
- Jeopardy!, computerised competitor 98–104
- job creation 9, 10, 19, 53, 164, 241
  - decline xi–xii, 43, 44, 170
- job loss
  - see also* unemployment
  - agriculture 26–7
  - automation 27, 50–1, 80, 96–7, 107–10
  - car industry 184, 185–6
  - from cloud computing 107, 108–9, 130
  - construction industry 175
  - developing countries 222
  - in digital market 79
  - downward spirals 207

during recession 41, 42  
finance sector 117  
food industry 16, 174–5  
graduates xv, 87–8, 129–31, 135, 148, 167  
high income groups 208  
high-skilled jobs 121, 123–4, 130–1, 251  
through machine learning algorithms 97–8, 126, 226  
manufacturing industry ix, 9, 54, 56, 174, 221  
through outsourcing 9, 12, 61, 108, 117–24  
pharmacies 167  
polarization of jobs 51–2  
quality of jobs 50–1  
university staff 146, 148  
jobless recovery 34, 44–5, 45, 54  
jobs market 251, 282n  
  *see also* job creation; job loss  
  polarization 50–2  
journalism, automated copy 85–7

Karabarbounis, Loukas 41–3  
Kennedy, John F. Jr (President) 248, 279  
Keynes, John Maynard 40, 200  
Kinect technology 4–5, 7  
King, Dr. Martin Luther (Jnr), technological predictions 30  
kiosk automation 18–20, 21  
Kiva Systems 17, 18  
knowledge-based occupations  
  automation 87–8, 95–6, 97–8, 107–8, 208  
  human-machine collaboration 124–9  
  outsourcing 120–1  
Koza, John 112  
Kroger Company 17–18  
Krugman, Paul 198, 200  
Kurzweil, Ray 80, 229, 230–2

labor productivity, defined 35n  
  *see also* productivity  
labor share of income xii, 39–43, 53, 57, 59  
law graduates 127–8  
*Law, Legislation and Liberty* (Hayek) 256–7  
Leigh, David 244  
leisure time 262  
*Lights in the Tunnel, The* (Ford) xiii–xiv, 61, 262  
Lipson, Hod 110–12, 174  
“liquidity trap” 213n

litigation 156, 177–8, 184–5  
 London Datastore 89–90  
 London Symphony Orchestra 113  
 long-tail distribution 78–81, 79  
 long-term unemployment rate 206, 279  
 low-income jobs 14–16, 51, 164, 204, 275–6, 279  
   loss 27  
  
 McAfee, A. 61–2, 124–5  
 McDonald's 13–14, 16, 204–5  
 machine intelligence 74, 75  
   *see also* algorithms; Artificial General Intelligence; artificial intelligence  
 machine learning 91–4, 95, 97–8, 115, 121, 126, 131, 134  
 machine marking 133–6  
 machine-human symbiosis 124–9, 230–1  
 Manchester University, nanotechnology research 244  
 manufacturing industry  
   automation 2–3, 5–6, 8–10, 10–12, 56, 173–4, 221  
   employment 3, ix, 9–10, 54, 56, 174  
   wages/productivity split 38–9  
 market economies 200–3, 258, 259, 263–5  
   *see also* consumer spending  
 marking, by machines 133–6  
 mass market economies *see* market economies  
 Mayo Clinic 155  
 MD Anderson Cancer Centre 153–5  
 MD Buyline, Inc. 105  
 means testing, basic guaranteed income 261  
 media, automation 85–7  
 medical sensors 165–6  
 medicine, use of AI 104, 105, 153–9, 165–6  
   *see also* health care  
 Mercedes Benz 177  
 Merck & Co. 174  
 microprocessors 70–2  
 middle class, job loss 50–1, 80, 87–8, 96–7, 106, 185, 186, 198  
 miniaturization, computer hardware 72  
 MIT (Massachusetts Institute of Technology) 5, 137, 142, 217, 233, 238, 253  
 mobile devices 20–1, 22–3, 80–1, 105, 205  
 molecular machines 239–41, 244  
 Momentum Machines, Inc. 12–13  
 MOOCS 136–49  
 Moore, Gordon, view of Singularity 233  
 Moore's Law xii–xiii

climate change 283  
computer development 65, 70, 72, 72, 83  
data 88  
machine learning 95  
super-intelligence 228  
Murray, Charles 261  
music, creation by computers 113–14

nano-filters 241  
*Nanosystems* (Drexler) 238  
nanotechnology 73n, 237–44  
Narrative Science, Inc. 86–7  
narrow artificial intelligence 225–6  
National Health Service 259, 277–8  
National Institute of Informatics (Japan) 131  
National Nanotechnology Initiative (NNI) 238, 239  
natural language capability 100–3, 121  
Neiman, Brent 41–3  
neural networks 93–4, 115, 123, 155  
nontradable services 56  
Norvig, Peter 136, 137

offshoring *see* outsourcing  
older people 161–5, 217–18  
online businesses 16–17, 78–81, 105, 144, 262  
online courses 136–49  
open source software 262  
Open University 138, 142  
Osborne, M. A. 218  
*Our Final Invention* (Barrat) 234  
outsourcing (offshoring)  
  electronic 61, 66, 108, 117–24, 148  
  and job loss 9, 12, 54, 61, 108, 117–24  
  reversal *see* reshoring  
overqualification 49–50, 130, 157–8, 249, 250, 282n  
Oxbridge universities, and online courses 146

Page, Larry 232  
Painting Fool, The 114–15  
part-time jobs 51, 279, 282n  
pay *see* wages  
Peltzman effect 265–6  
pensions and retirement 217–18, 219  
people analytics 95

permanent income hypothesis 198n, 205  
pharmacies, automation 159–60, 167  
Piketty, Thomas 273–4  
Piquant 101–2  
plagiarism, online courses 141, 142  
*Player Piano* (Vonnegut) (novel) 32  
plutocracies 214–15  
polarization of jobs 50–2  
police, algorithmic crime prediction 89  
politics  
    influences on government 48, 59, 61  
    viewpoints 159–60, 256–9  
pollution, reduction in agriculture 25  
postgraduate qualifications 50, 139  
poverty, and incentives 260–1, 278  
    *see also* income inequality; low-income jobs  
*Prey* (Crichton) (novel) 240  
Princeton University 137  
*Principles of Economics* (Bernanke) 39  
*Principles of Economics* (Taylor and Weerapana) 38  
prisons, private sector contracts 259  
privacy issues, big data 90  
productivity  
    and automation 33, 34, 53, 54, 56, 78, 210–11  
    and decline in wages xi, 34–9, 36, 37, 282  
    defined 35n  
    increases x, 41  
    in recession 201–2  
    stress for workers 11–12  
professional jobs *see* graduates; white-collar jobs  
public spending cuts, economic stimulus 199  
  
qualifications, university 140, 142–3, 147, 148, 249, 250  
Quill software 86–7  
  
*Race Against the Machine* (Brynjolfsson and McAfee) 61  
*Radical Abundance* (Drexler) 239, 242  
radiology, medical imaging automation 158–9  
real income 47  
recession 201–2, 210, 212–13  
    *see also* Great Recession  
religion, and immortality quest 231–2  
remote-controlled machinery, and outsourcing of jobs 122  
remote-presence robots 8  
report writing automation 87

research, impact of information technology 70, 110–12  
reshoring, manufacturing jobs 8–10  
retail industry 16–21, 89  
Rethink Robotics 5–6, 7  
retirement 217–18  
reverse engineering 233–4  
risks  
    in automation 254–5  
    economic 265–6, 272–3  
road accidents 177–8, 179  
Robot Operating System (ROS) 6, 7  
robotic vehicles *see* autonomous cars  
robotics explosion 6–8  
robots  
    in agriculture 23–7  
    cloud robotics 21–3  
    in distribution centres 17–18  
    in fast food industry 15, 16  
    in health care 160–1  
    in manufacturing industry 2–3, 5–6, 10, 11, 12  
    and outsourcing 122  
    for university tutoring 147–8  
    visual perception 2, 3–5, 6  
  
S-shaped curve 68–70, 69, 71–2, 72, 248–9  
salaries *see* wages  
savings (money) 206, 219  
Schmidt, Michael 110–12  
scientific and technical jobs 130, 250  
secondary schools, pupil achievement 248–9, 261–2  
security  
    concerns over cloud robotics 23  
    robotic technology 8  
selective universities, and online courses 146  
self-driving cars xiii–xiv, 96, 175–86  
self-learning systems 96, 115  
self-service retail services 18–20  
semiconductor technology 71–2  
service industries 12–21, 56  
*Shallows, The* (Carr) 252  
Singularity 229–34  
*Singularity is Near, The* (Kurzweil) 230  
Singularity University 230  
skill biased technological change (SBTC) 49, 203–4  
skilled jobs, effects of automation 27, 49, 87–8, 129–31, 135, 148, 167, 203–4, 251

Smalley, Richard 240–1  
 smartphones 20–1, 22–3, 80–1, 105, 205  
 Smith, Noah 215, 272  
 social mobility *see* economic mobility  
 software 73–4  
     automated writing 85–8, 95–6  
     cloud computing facilities 106–7, 108, 109, 112  
     legal document review 127–8  
     machine learning 91–6  
     primary research 110–11  
     project management 97  
     for robotics 6, 7  
 solar power 283  
 Solow, Robert 67, 197–8  
 spam filters 91  
 Stanford University 136, 176  
 statements of accomplishment 137, 140  
 StatsMonkey 86  
 Stiglitz, Joseph 197  
 stock exchange, automated trading algorithms 115  
 STRANDS project 8  
 student loans, debt burden 129, 209  
 Stuxnet worm 23  
 subprime loans 214  
*Super Crunchers* (Ayres) 128  
 super-intelligence, General Artificial Intelligence 226–37  
 supercomputers, cloud availability 106  
 surgical robots 160–1  
 Switzerland, guaranteed income proposal 267  
 SyNAPSE 74  
  
 taxation 199, 260, 270, 271, 276–7  
 taxi drivers 184, 204  
 Taylor, John B. and Weerapana, A. 38–9  
 techno-feudalism 214–15, 264–5  
 technology  
     *see also* automation; information technology; robotics; robots  
     and economic growth 49–50, 52–5, 67, 188–90, 210–11, 213  
     innovation 52–3, 65, 66, 67, 68–70, 69, 71–2, 72  
     predictions 30–4, 60–2  
     effect on productivity 33, 34, 53, 54, 56  
 Tegmark, Max 225, 233  
 telepresence robots 122, 163  
 Tesla electric car company 3  
 textile industry 8–9, 10, 12



Thiel, Peter 66, 232  
thinking machines 226–7  
  *see also* Artificial General Intelligence (AGI)  
three-dimensional *see* 3D  
Thrun, Sebastian 17, 136, 137, 138, 176, 255  
trade unions 58–9  
*Transcend* (Kurzweil and Grossman) 231  
*Transits - Into an Abyss* (music composition) 113  
translation tools, Google 92, 123–4  
transportation 23, 85  
Triple Revolution report 30–1, 33, 248  
trucks, automation 23, 185  
Turing, Alan 226  
TurtleBot robotics kit 7  
two-dimensional vision 3, 6

Uber car service 185–6, 204

Udacity 137, 138–9

unemployment

*see also* job loss

  job creation decline 43, 44, 170

  labor participation rate 42, 46n

  in recession 44–6

  trends 205–6

United Kingdom

  basic income implementation 270–1

  cloud computing 109

  data on city life 89–90

  elderly population 161, 164, 217–18

  employment 14–15, 46, 47, 51, 130–1, 250

  finance sector 57, 115, 117

  graduate jobs 50, 123, 130–1, 250

  health care litigation 156

  house prices 211

  income inequality 47, 47, 48

  industry 9, 14–15, 173, 175

  investment 68, 274–5

  job loss 52, 122

  labor participation rate 46n

  labor's share of income 39–40, 42

  low-income jobs 206, 279, 282

  machine marking 133, 134

  middle classes role 117

  nanotechnology research 244

  National Health Service 259

  online courses 138, 143, 144

- effect of outsourcing 120
- productivity and wages xi, 37, 38, 46, 47, 282
- reshoring of businesses 10
- robotic security guard project 8
- social mobility 47
- tax credits 260, 276
- university fees and costs 129, 144–5, 209
- university readiness 249
- Universal Credit 260, 276
- universal translation 123–4
- universities
  - fees and costs 145–6
  - effect of MOOC 139–43, 146–7
  - qualifications 140, 142–3, 147, 148, 249, 250
  - robot tutoring 147–8
- University of Birmingham, robotic security project 8
- university credit, online courses 140
- University of Sheffield 173
- University of Southampton 144
- unstructured data 89
  
- vending machine automation 18–20, 21
- Vinge, Vernor 229
- virtual communication 8, 95–6
- virtual environments *see* electronic offshoring
- virtual immigration 119
- visual perception, in robots 2, 3–5, 6, 24
- voluntary service, incentives 262
- von Neumann, John 229
- Vonnegut, Kurt, *Player Piano* 32
  
- wages
  - growth x, 46, 53, 57
  - stagnation and productivity x, 34–9, 36, 37, 282
  - zero hours contracts 15, 51, 279, 282n
- Walmart 20
- warehouses, automation 17–18
- Watson (computer intelligence) 102–6, 108, 153–5
- WatsonPaths 104–5
- wealthy elite *see* financial elite; high income groups
- welfare state 256, 258–9
- white-collar jobs, automation xv, 50–1, 80, 87–8, 96–7, 106, 107–8
- Wiener, Norbert, vision of technology 31–2, 33–4
- Wilczek, Frank 225
- Willow Garage, robotics kit 7

“winner take all” markets 78–9, 79, 81, 109, 175

*Winner Take All Politics* (Hacker and Pierson) 59

workforce

*see also* employment; graduates; job creation; job loss; low-income jobs; white-collar jobs

as consumers 187–8, 191, 206, 208, 209, 217

drop-out due to basic income guarantee 267–8

increases 279

Internet companies 169

problems in agriculture 25

prospects for non-graduates 124

stress 11–12

WorkFusion 97–8

writing software 85–7, 87–8, 95–6

youth unemployment 216–17

YouTube 169

zero hours contracts 15, 51, 279, 282n