Can Robots and AI Help Solve Skills Shortages?

Tom M. Mitchell
Carnegie Mellon University
Up to 30% of existing UK jobs could be impacted by automation by early 2030s, but this should be offset by job gains elsewhere in economy.
AI is progressing rapidly
Computer Vision

Imagenet Visual Recognition Challenge

Error rate

Human level

Imagenet 2015
Speech Recognition

October 2016: Microsoft reports reaching human-level accuracy of 94.1% at standard switchboard task.

March 2017: IBM reports 94.5% accuracy
Robots
Factories, Land, Air, Sea, Mines, Homes


FIGURE 2.5 Robot application areas in 2015. SOURCE: Data from International Federation of Robotics, 2015.
Games and reasoning

Chess

Go

Jeopardy

Poker
The key: Machine Learning

- Conversational agents
- Fraud detection
- Vision
- Translation
- Recommendations
- Self-driving
Sweet spot for Machine Learning

Learn to make decisions where:

• inputs are well-defined and online
• many historical examples of correct decisions (training)
• decision depends on potentially many variables
  → difficult for human, requires human training, takes time, ...
• speedy decisions valuable

Examples:

• approve credit card transactions
• detect email spam
• text crisis hotline
• many routine decisions based on online data
  – vacation requests, trip reimbursements, ...
Routine Workflow Automation

Clara, can you find a time for us to meet next week?

Clara is your partner in doing great work — a virtual employee that schedules your meetings.

Add work email to get started

START FREE TRIAL

→ new business model
Automated investing that keeps your best interests in mind.

Get Started

TELL US ABOUT YOURSELF

I am 35 years old and I want to invest for the long term.

My household income is $100,000 of which I save 0-10%.

My liquid assets are worth $75,000 and my risk tolerance is very high.

Build My Investment Plan
We recommend a Growth Portfolio for you.

Edit Risk Tolerance

STANDARD ALLOCATION

- Emerging Mkt Bonds: 7%
- Emerging Mkt Equities: 24%
- International Equities: 25%
- U.S. Equities: 41%
- TIPS: 3%

90/10 STOCKS/BONDS

View Tax-Sheltered Allocation

PLAN FEATURES

- More Returns, Less Risk
- Personalized Allocation
- Automatic Rebalancing
- Tax Efficient
- Geographically Diversified
- Cash Minimized
- Passive Investing with ETFs
- Hassle-Free
- Low Fees
- Personal Advisor
Robo-advisors:
Assets under management
SigFig: $70 M
Betterment: $7 B
TradeKing: $45 M

FORECAST: Global Assets Under Management By Robo-Advisors

Source: BI Intelligence

BI Intelligence

Cash Minimized
Passive Investing with ETFs
Hassle-Free
Low Fees
Geographically Diversified
Personal Advisor
But what about skill shortages in human-human social skills?
But what about skill shortages in human-human social skills?

Even in these jobs, AI may help by freeing humans to spend time on the tasks that most require a human.
A Job is a **Set of Tasks**

- Job = physician
  Tasks = \{diagnose, treat, discuss with patient, bill\}

→ automate/augment routine tasks, freeing time for tasks requiring human-human interaction

Skin cancer:

trained program
outperforms
doctor diagnoses
[Nature, 2017]
A Job is a **Set of Tasks**

- **Job** = customer service representative
  
  **Tasks** = \{understand problem, provide information, perform transaction, guide customer\}

AI : automatically handle 32% of calls, and learning...

→ automate/augment routine tasks, freeing time for tasks requiring human-human interaction
Rise and Fall of Secretarial Jobs

Source: IPUMS-USA, University Of Minnesota
Credit: Quoctrung Bui/NPR
Potential for AI Impact on Skills Training

1. Online dissemination of courseware → greater access (though greatest benefit is to the already-educated)

2. Early progress on AI courseware to offer better training (by adapting curriculum, customizing to student)
Choose your program, land your dream job

Enroll in Nanodegree Plus, and you'll get hired within 6 months of graduating, or we'll refund 100% of your tuition. That's the kind of confidence we have in you. We know that empowering yourself through learning, acquiring critical skills, and pursuing career advancement are life-changing steps to undertake. And we know they require commitment and hard work. But we'll support you every step of the way—from enrollment, to getting hired.
Nanodegree Plus Programs

Terms and Conditions

Machine Learning Engineer

Full Stack Web Developer

Android Developer
Summary

• AI is automating/assisting an increasing range of tasks
• Assembly line → doctors, investment advisors, lawyers
• Most jobs involve a SET of tasks
• AI roles in jobs with social skills shortages
  – triage
  – train/advise
  – off load non-social tasks
• AI for targeted, customized skill training
Summary

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Potential game changers:
• computers that really read.
• superhuman recognition of facial emotion expressions
EXTRAS
### Fastest growing occupations to require job preparation, social skills or both

Projected growth of jobs requiring average to above average ... (2014-2024)

<table>
<thead>
<tr>
<th>Job prep</th>
<th>Social skills</th>
<th>Physical skills</th>
<th>Analytical skills</th>
<th>Projected growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
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<td>✓</td>
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<td>7.9</td>
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<td>7.1</td>
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<td>6.2</td>
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<td>5.6</td>
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<tr>
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<td></td>
<td>-10.5</td>
</tr>
</tbody>
</table>

Sources: Pew Research Center (skills and preparation ratings), Bureau of Labor Statistics (growth rates).

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### Job growth by major occupational grouping, 2014-2024

<table>
<thead>
<tr>
<th>Occupational Group</th>
<th>Projected Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math</td>
<td>28.0%</td>
</tr>
<tr>
<td>Healthcare</td>
<td>18.6</td>
</tr>
<tr>
<td>Personal care and service</td>
<td>13.1</td>
</tr>
<tr>
<td>Computer and information tech.</td>
<td>12.5</td>
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<tr>
<td>Community and social service</td>
<td>10.5</td>
</tr>
<tr>
<td>Construction and extraction</td>
<td>10.1</td>
</tr>
<tr>
<td>Business/financial operations</td>
<td>8.4</td>
</tr>
<tr>
<td>Education, training, and library</td>
<td>7.5</td>
</tr>
<tr>
<td>Life, physical, and social science</td>
<td>7.4</td>
</tr>
<tr>
<td>Food preparation and serving</td>
<td>6.5</td>
</tr>
<tr>
<td>Installation, maintenance, repair</td>
<td>6.4</td>
</tr>
<tr>
<td>Building cleaning/maintenance</td>
<td>6.2</td>
</tr>
<tr>
<td>Entertainment and sports</td>
<td>5.9</td>
</tr>
<tr>
<td>Management</td>
<td>5.5</td>
</tr>
<tr>
<td>Legal</td>
<td>5.1</td>
</tr>
<tr>
<td>Sales</td>
<td>5.0</td>
</tr>
<tr>
<td>Transportation, material moving</td>
<td>4.8</td>
</tr>
<tr>
<td>Protective service</td>
<td>4.5</td>
</tr>
<tr>
<td>Media and communications</td>
<td>4.2</td>
</tr>
<tr>
<td>Architecture and engineering</td>
<td>2.6</td>
</tr>
<tr>
<td>Arts and design</td>
<td>2.2</td>
</tr>
<tr>
<td>Office and administrative support</td>
<td>2.0</td>
</tr>
<tr>
<td>Production</td>
<td>-3.1</td>
</tr>
<tr>
<td>Farming, fishing, forestry</td>
<td>-5.9</td>
</tr>
</tbody>
</table>

To grasp the impact of technological automation, we structured our analysis around 2,000 distinct work activities.

**Occupations**
- Retail salespeople
- Food- and beverage-service workers
- Teachers
- Health practitioners

~800 occupations

**Activities (retail example)**
- Greet customers
- Answer questions about products and services
- Clean and maintain work areas
- Demonstrate product features
- Process sales and transactions

~2,000 activities assessed across all occupations

**Capabilities**

**Social**
- Social and emotional sensing
- Social and emotional reasoning
- Emotional and social output

**Cognitive**
- Understanding natural language
- Generating natural language
- Retrieving information
- Recognizing known patterns/categories (supervised learning)
- Generating novel patterns/categories
- Logical reasoning/problem solving
- Optimizing and planning
- Creativity
- Articulating/displaying output
- Coordinating with multiple agents

**Physical**
- Sensory perception
- Fine motor skills/dexterity
- Gross motor skills
- Navigation
- Mobility

Source: Expert interviews; McKinsey analysis