World Campus / Learning Design
AI Team Summary Report

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Overview

This summary report consists of three sections - what is AI, when will we see AI in education, and how is AI developed. While the timeline for general AI is longer than many expect, we should start seeing narrow AI in education within the next 2-3 years. Effectively preparing to adopt and use AI in organizational processes will likely require shifting to an AI first mindset, considering the implications of AI in the organization, developing use cases and quality data for AI applications, as well as in-house AI expertise.

Section 1: What is AI?

As shown in Figure 1,

- **Artificial intelligence (AI)** can be defined as any technique that enables computers to mimic human intelligence, using logic, if-then rules, decision trees, and machine learning (including deep learning).
- **Machine Learning (ML)** is a subset of AI that includes abstruse statistical techniques and enable machines to improve at tasks with experience (including deep learning).
- **Deep Learning (DL)** is a subset of machine learning and is composed of algorithms that permit software to train itself to perform tasks, like speech and image recognition, by exposing multilayered neural networks to vast amounts of data.
- Finally, **Neural Networks (NN)** are a type of machine learning modeled after the human brain.

Figure 1. The difference between artificial intelligence, machine learning, deep learning, and neural networks. Adapted from *Artificial Intelligence 101: Everything You Need to Know to Understand AI*.

As shown in Figure 1,
How Does AI Learn?

As shown in Figure 2, AI can be taught a task through supervised learning, unsupervised learning, and reinforcement learning.

**Supervised learning uses labeled data - the model knows what to learn.** The model uses previously labeled training examples and historical data, analyzing recurring patterns thereby learning to recognize new ones and forecast future events. Branches of supervised learning include classification and regression. Classification can be used to detect identity fraud, classify images, retain customers and diagnostics. Regression can be used to predict advertising popularity or population growth, forecast weather or markets, or estimate life expectancy.

**Unsupervised learning uses unlabeled data - the model looks for patterns and groups within data.** The model analyzes an unlabeled dataset, models clusters by type and attributes to find common traits, and uses a cost function to tell a neural network how far off it was, then continues to adjust to increase the accuracy of the algorithm. Branches of unsupervised learning include dimensionality reduction and clustering. Dimensionality reduction can be used to elicit features, discover structure, provide meaningful compression, and big data validation. Clustering can be used in recommender systems, customer segmentation, or targeted marketing applications.

**Reinforced learning - once rules are specified, the model finds the best ways to earn the greatest reward.** The model will perform a loop many times in order to find the best strategy. The model is rewarded for good results and punished for poor results. Reinforced learning is used for real-time decision making, robot navigation, learning tasks, skill acquisition, and game AI. (DeMuro, 2018; EnhanceDataScience, 2017; Jha, 2017).
Anticipated Phases of AI Development and Timeline

As shown in Figure 3, the anticipated phases of development of AI flows from **artificial narrow intelligence (ANI or "weak AI")** which is limited to a single task, is not self-aware, and is where AI is now. Next is **artificial general intelligence (AGI)** which is expected to include the ability to reason, plan, and handle complex concepts. Finally comes **artificial super intelligence (ASI)** where programs are anticipated to become smarter than all of the collective minds on earth (Biddle, 2017).

We're currently in the early phases of AI and how quickly AI will advance is uncertain. To herald the transition from ANI to AGI, experts in a 2016 White House report identified three milestones to indicate the approach of AGI: 1) success at broader, less structured tasks; 2) unification of different "styles" of AI methods; and 3) solving specific technical challenges, such as transfer of learning (NTSC Subcommittee on Machine Learning, 2016). As for when we might see ASI, a March of 2016 survey of 80 Fellows of the American Association of Artificial Intelligence found that 67.5% believe that it will take more than 25 years to achieve ASI and another 25% believe that it will never happen. Only 7.5% thought it could be in the next 10-25 years (Etzioni, 2016).

When should organizations begin to implement AI? According to a recent webinar for *MIT Sloan Management Review*, organizations positioned for early adoption of AI are likely to experience a significant advantage over competitors. Fast adopters with an innovator focus are estimated to see a 7% effect on yearly profit growth, followed by fast adopters with an efficiency focus (4%), AI followers with innovator focus (2%), AI followers with an efficiency focus (-1%), and those who are AI resistant (-7%) (Bughin and Michelman, 2018).

The current progress and enthusiasm for AI is driven by three factors - the **availability of big data**, which provides raw material for **dramatically improved machine learning approaches and algorithms**, which relies on the capabilities of **more powerful computers** (NTSC Subcommittee on Machine Learning, 2016). The advancement of ML and DL are dependent on the expansion and improvement of neural networks. However, bottlenecks in internet bandwidth could affect the data distribution pipeline for developed AI applications, like autonomous vehicles, in the short term (Hecht, 2016).
Section 2: When Will We See AI in Education?

As part of the fourth industrial (digital) revolution currently underway, we should expect continued growth in AI in education and industry generally. The 2018 NMC Horizon Report (Becker et al., 2018) puts the time to adoption of (early) AI in education at 2-3 years and the Artificial Intelligence Market in the US Education Sector 2017-2021 report suggests a 47.5% growth in education AI between 2017-2021. Additionally, a 2019 Forbes article lists education as one of the 13 industries soon to be revolutionized by artificial intelligence (Forbes, 2019). For industry overall, a 2019 Gartner survey of CIOs shows 37% of organizations have implemented AI in some form and experienced a 270% growth in AI over the past four years (Gartner, 2019).

Understanding how AI learns may help visualize potential AI growth generally - slowly at first then exponential growth and mastery (see short (01:26) YouTube video demonstration from Demis Hassabis from Google Deep Mind at Computer teaches itself to play games - BBC News).

* DevOps (development and operations) is an enterprise software development phrase which consists of a combination of cultural philosophies, practices and tools used in agile development.
Thinking About AI First

The nature of AI, where the technology starts making decisions for us instead of us asking a computer to execute a specific command, shifts computer interactions from reactive to proactive (Tinworth, 2019), which have organizational and workflow implications. Employee tasks may become more about managing AI over larger areas of responsibility than performing specific functions - the ability to understand and predict the behavior of advanced AI systems may provide additional challenges and even the best models can fail in unpredictable ways. However, tests using a combined approach with both AI and human input have shown lower error rates than either working alone (NTSC, 2016).

Eliot Knudsen from Datamation suggests three rules for transformation into an AI first organization as
- focusing on singles and doubles across an application instead of home runs;
- understanding the problem then matching the technology to the problem; and
- addressing data messes before engaging algorithms.

Major companies like Apple, Amazon, Facebook, Google, and Microsoft are making large investments in AI (Novet, 2018; Morgan, 2018; Harwell, 2018) and all have acquired AI companies to speed their AI strategies (Microsoft, n.d.-a). A CNBC article states that "Amazon is quickly becoming an AI company" (Wang, 2017), Google announced that it was going from "mobile first to AI first" (Analytics India Magazine, 2017), and Microsoft aims to help turn every industry into one driven by artificial intelligence (Broersma, 2018).

We should continue to see AI applications develop and expand with possible exponential growth and we may also want to start thinking "AI first" and what that would mean to online learners at Penn State. For instance, how would our organization, workflow, and student supports change if AI could detect when students were having difficulty and provided them with intervention options or assistance? Would we then have automated routing to AI tutors and remedial materials? Periodic self-checks that are AI initiated? How would course design or accessibility or learning pathways or media options provided to students change? What type of data visualization or dashboards or data management and governance changes would be needed? Effectively implementing AI may mean restructuring our organizational makeup, developing new training models, and reevaluating hiring practices. Our chances of successful AI implementation may depend on our ability to reorganize our core business processes around AI (Lindzon, 2017; Transform Staff, 2018). Successful implementation of AI within our organization may also provide new partnership opportunities both within and outside of PSU.
Current Uses of AI
Based on case studies analyzed for MIT Sloan, AI is generally being used for natural language processing (NLP), natural language generation (NLG), vision, machine learning, virtual assistance (VA), and advanced robotics. The highest percentage of use cases being virtual assistants in customer service at 47% and advanced robotics in operations at 50% (Bughin and Michelman, 2018). According to a recent Harvard Business Review (HBR) article, AI is currently being used in industry for three main applications:

- **routine process automation** (e.g., routing records and updates, automating processes, reconciliation, extracting information);
- **gaining cognitive insights** (e.g., detecting, identifying and analyzing patterns); and
- **cognitive engagement** (e.g., 24/7 customer service, answering employee questions and providing recommendations) (Davenport, T., Ronanki, R., 2018).

Additionally, a 2017 Deloitte survey of 250 executives revealed the primary business benefits of AI currently in use as

- enhancing features, functions and performance of products;
- optimizing internal business operations;
- freeing up workers to be more creative by automating tasks;
- making better decision; creating new products;
- optimizing external processes; pursuing new markets; and
- capturing and applying scarce knowledge where needed.

For a sampling of current AI companies expected to have an impact on the future of AI, read 31 artificial intelligence companies building a smarter tomorrow.

Potential Role of AI in Education
In the 2018 article, 7 roles for artificial intelligence in education, Matthew Lynch suggests that the role of AI in the classroom will include automated grading, providing support to teachers for routine tasks and some student communications, serving as a lifelong learning companion to support students, acting as a personalized learning companion and tutor, adapting materials to help students with special needs, and identifying weaknesses in curriculum or classrooms.

Using the three AI types outlined in the HBR article for categorization purposes and adding a fourth category for education and training, some key areas for AI in education in the shorter term include

**Routine Process Automation**
- streamlining tedious administrative tasks and processes;
- scaling up tasks like evaluating transfer credits and microcredentialing;
- automating or assisting with grading;

Source: The Pennsylvania State University
• providing accessibility through automated captioning, voice recognition, adapting and converting materials;

**Gaining Insights**
• managing the campus and campus safety;
• analyzing research, diagnosing problems and finding answers;
• analyzing curriculum to identify weaknesses and making improvements or answering questions (e.g., program standards or 21st century skills);

**Engagement**
• feedback, such as recording, organizing, and providing detailed feedback from and to students via AI-enabled chatbots, automating some student-teacher communications;
• navigation, such as helping students, faculty and staff navigate processes and systems, finding answers to frequently asked questions, and serving as classroom assistants;
• affect in online education through facial recognition, such as being able to see when a student is struggling;
• providing virtual patients or stand-ins for training purposes;
• providing personalized learning and tutoring;

**Education and Training**
• advancing and integrating AI into education to help address the skills shortage

Using facial recognition to detect whether students are concentrating or distracted can help determine students who are gifted or struggling. Source: *60 Minutes*

Tables 1-4 further uses these categories to show a sampling of AI initiatives in higher education.

**Table 1. Routine Process Automation**

<table>
<thead>
<tr>
<th>University or Organization</th>
<th>AI Initiative</th>
<th>Links or References</th>
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</thead>
<tbody>
<tr>
<td>EdX</td>
<td>Automated grading software for grading essays available free on the web to any institution that wants to use it</td>
<td><em>Essay-grading software offers professors a break</em> (NY Times)</td>
</tr>
<tr>
<td>Gradescope</td>
<td>AI-enabled grading</td>
<td><em>Professors of the world, rejoice: Gradescope bring AI to grading</em> (NVIDIA)</td>
</tr>
<tr>
<td>Massachusetts Institute of Technology</td>
<td>Experimented with robo-grading and decided not to use it</td>
<td><em>Pushing the boundaries of learning with AI</em> (Inside Higher Ed)</td>
</tr>
</tbody>
</table>

Tables 1-4 further uses these categories to show a sampling of AI initiatives in higher education.
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<tr>
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</thead>
<tbody>
<tr>
<td>Penn State</td>
<td>BBookX, allows you to build a book (same goals as Eureka)</td>
<td>BBookX</td>
</tr>
<tr>
<td>Penn State</td>
<td>Eureka, provides novel ways to explore Wikipedia to dynamically generate zero-cost materials to support learning</td>
<td>Eureka!</td>
</tr>
<tr>
<td>Penn State</td>
<td>Question Builder, rapidly generates quiz questions based on samples of unstructured text</td>
<td>Question Builder</td>
</tr>
<tr>
<td>Penn State 2018 Nittany AI Challenge</td>
<td>LionPlanner simplifies academic planning by providing full modifiable plans for all semesters and consolidating resources and requirements</td>
<td>2018 Nittany AI Challenge winners provide EdTech solutions, receive $50,000 (Penn State News)</td>
</tr>
<tr>
<td>Penn State 2018 Nittany AI Challenge</td>
<td>Micro to Macro applies ML to scale up competency-based learning, integrating human and algorithmic grading</td>
<td>IST faculty, students well represented in Nittany AI Challenge finals (Penn State News)</td>
</tr>
<tr>
<td>Penn State 2018 Nittany AI Challenge</td>
<td>Scaling up the University Libraries' digital badge program</td>
<td>Penn State team tackles surge of digital badge usage in Nittany AI Challenge (Penn State News)</td>
</tr>
<tr>
<td>Penn State 2017 Nittany Watson Challenge</td>
<td>Transfer credit evaluation</td>
<td>Penn State team addresses transfer credit challenge using IBM Watson (Penn State News)</td>
</tr>
<tr>
<td>Quottly!</td>
<td>Finds accredited and transferable college courses to fulfill degree requirements</td>
<td>Are AI-powered chatbot tutors the future of textbooks? (EdSurge)</td>
</tr>
<tr>
<td>Wildfire Learning</td>
<td>Uses Wikipedia information to create content</td>
<td>Take any text, powerpoint or video and 1-click creates active learning (Wildfire)</td>
</tr>
</tbody>
</table>

Source: The Pennsylvania State University
<table>
<thead>
<tr>
<th>Institution</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Georgia Institute of Technology</td>
<td>Virtual ecological research assistant to model ecological scenarios</td>
<td><em>Pushing the boundaries of learning with AI</em> (Inside Higher Ed)</td>
</tr>
<tr>
<td>Georgia State</td>
<td>Big data tracking of individual student performance</td>
<td><em>Artificial intelligence will transform universities. Here’s how</em> (World Economic Forum)</td>
</tr>
<tr>
<td>Harvard Business School</td>
<td>Uses DataRobot to help students make predictive models without first learning how to code</td>
<td><em>Pushing the boundaries of learning with AI</em> (Inside Higher Ed)</td>
</tr>
<tr>
<td>Penn State</td>
<td>Real-time optimization for adaptive removal of snow (ROARS)</td>
<td><em>Could software put an end to the snow day at Penn State?</em> (Government Technology)</td>
</tr>
<tr>
<td>Penn State 2018 Nittany AI Challenge</td>
<td>Pathfinder uses ML to recommend effective course pathways based on past course enrollment and performance data of other students</td>
<td>IST faculty, students well represented in Nittany AI Challenge finals (Penn State News)</td>
</tr>
<tr>
<td>Penn State 2018 Nittany AI Challenge</td>
<td>ProFound professor search engine that retrieves all publicly available information about a professor, searchable by name or research area</td>
<td>2018 Nittany AI Challenge winners provide EdTech solutions, receive $50,000 (Penn State News)</td>
</tr>
<tr>
<td>Reed Elsevier</td>
<td>Literature reviews, checking plagiarism, misuse of statistics</td>
<td><em>Artificial intelligence will transform universities. Here’s how</em> (World Economic Forum)</td>
</tr>
<tr>
<td>Stanford University</td>
<td>Uses machine learning to address global poverty through satellite imagery analysis</td>
<td>Sustainability and artificial intelligence lab</td>
</tr>
<tr>
<td>TAL Education Group (China)</td>
<td>Affect in the classroom via facial recognition</td>
<td><em>Facial and emotional recognition: how one man is advancing artificial intelligence</em> (CBS News)</td>
</tr>
<tr>
<td>Worchester Polytechnic Institute</td>
<td>Qualitative analysis of video footage</td>
<td><em>Pushing the boundaries of learning with AI</em> (Inside Higher Ed)</td>
</tr>
<tr>
<td>University of St. Thomas</td>
<td>Qualitative analysis used in lecture halls to analyze student engagement</td>
<td><em>Pushing the boundaries of learning with AI</em> (Inside Higher Ed)</td>
</tr>
<tr>
<td>University of Texas at Austin</td>
<td>Traffic analysis</td>
<td><em>Artificial intelligence and supercomputers to help alleviate urban traffic problems</em> (Texas Advanced Computing Center)</td>
</tr>
</tbody>
</table>

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<tbody>
<tr>
<td>Arizona State</td>
<td>AdmitHub AI-powered chat bots used to recruit and enroll students</td>
<td>Pushing the boundaries of learning with AI (Inside Higher Ed)</td>
</tr>
<tr>
<td>Carnegie Mellon University</td>
<td>AI used to assist with collaboration in student group work</td>
<td>Pushing the boundaries of learning with AI (Inside Higher Ed)</td>
</tr>
<tr>
<td>Defense Advanced Research Projects Agency (DARPA)</td>
<td>AI digital tutor for the U.S. Navy to train workers on IT, students frequently outperform experts in both written tests and real world problem solving</td>
<td>DARPA Education Dominance Program Digital Tutor Assessments (Defense Technical Information Center)</td>
</tr>
<tr>
<td>Deakin University (Australia)</td>
<td>Deakin Geanie, a comprehensive student assistant for classroom and administrative tasks</td>
<td>Can a family of bots reshape college teaching (EdSurge)</td>
</tr>
<tr>
<td>Georgia Institute of Technology</td>
<td>Jill Watson, AI TA in online courses</td>
<td>Can a family of bots reshape college teaching (EdSurge) Next steps for Jill Watson (GA Tech) Pushing the boundaries of learning with AI (Inside Higher Ed)</td>
</tr>
<tr>
<td>Hubert</td>
<td>In-course student surveys via chatbot</td>
<td>Improvement starts with conversations (Hubert)</td>
</tr>
<tr>
<td>Massachusetts Institute of Technology</td>
<td>Pairs computer science students with alumni for feedback on student coding skills</td>
<td>Pushing the boundaries of learning with AI (Inside Higher Ed)</td>
</tr>
<tr>
<td>Ohio State</td>
<td>Using AI as virtual patients for medical student practice</td>
<td>Virtual reality check for medical students (OSU Virtual MedED)</td>
</tr>
<tr>
<td>Pearson and IBM Watson Education</td>
<td>Intelligent tutoring embedded in textbooks</td>
<td>Are AI-powered chatbot tutors the future of textbooks? (EdSurge)</td>
</tr>
<tr>
<td>Penn State</td>
<td>Lift! uses a support index to identify students in need of additional support, predictive of withdrawal and GPA</td>
<td>Lift! (Demo at WCLD Inspiration Session, Nov 2019)</td>
</tr>
<tr>
<td>Penn State Abington</td>
<td>Robotic pet that positively impacts the well-being of seniors and residents with disabilities</td>
<td>Abington faculty member received $5,000 IBM reward (Penn State News)</td>
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<tr>
<td>University or Organization</td>
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</tr>
<tr>
<td>California State University, Northridge</td>
<td>Exploring AI for • assistive technology (captioning, voice recognition, video description) • virtual tutors and assistants • research and student AI competitions</td>
<td>Artificial intelligence exploration (AIx) at CSUN (CSUN)</td>
</tr>
<tr>
<td>Carnegie Mellon University, U.S Navy</td>
<td>Partnership with U.S. Navy that allows CMU students to collaborate on AI projects</td>
<td>Navy, Carnegie Mellon enter education partnership (U.S. Navy)</td>
</tr>
<tr>
<td>Peking University (China), Sinovation's AI Institute, China's Ministry of Education</td>
<td>Partnership offering four month AI and machine learning courses</td>
<td>Ex-Google executive opens a school for AI, with China’s help (Wired)</td>
</tr>
<tr>
<td>Penn State Nittany AI Alliance</td>
<td>Partnering to drive innovation in higher education</td>
<td>Nittany AI Alliance</td>
</tr>
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### Ethics, Auditing and AI

While AI's ability to provide assistance to humans should continue to grow in the future, AI decisions are not always correct, can produce gray areas or probabilities that require further investigation, and the need for human monitoring and intervention should not be underestimated. As quoted from one of hosts of the *All Turtles* podcast, "Humans will not pay attention when the machine is doing a good enough job" (Collier, 2017). Algorithmic bias can be unintentionally introduced (Dastin, 2018; Simonite, 2018) with sometimes disturbing consequences (Stephen, 2018) and malicious use of AI is a possibility as well (Brahm, 2018). In the words of Stephen Hawking "...we can create AI for the good of the world. That it can work in harmony with us. We simply need to be aware of the dangers, identify them, employ the best possible practice and management, and prepare for its consequences well in advance" (Kharpal, 2017).

AI has and will continue to create ethical and social dilemmas that will need to be considered, like whether to identify when a user is interacting with AI. Providing processes for auditing, managing and intervening in AI decisions will be important areas to include in AI planning. A sampling of articles to read to further explain some of the ethical issues in AI include:

- [The ART of AI - Accountability, Responsibility, Transparency](https://medium.com/the-art-of-ai/the-art-of-ai-accountability-responsibility-transparency-3355df5b6a5b) (Medium)
- [Toward ethical, transparent and fair AI/ML: a critical reading list](https://medium.com/toward-ethical-transparent-and-fair-ai-ml-a-critical-reading-list-96d2c2688b49) (Medium)
- [Google's Mysterious AI Ethics Board Should Be Transparent Like Axon's](https://www.forbes.com/sites/ericpariser/2018/04/05/googles-mysterious-ai-ethics-board-should-be-transparent-like-axons/) (Forbes)
- [Is Ethical AI a Myth or Can It be Achieved?](https://www.analyticsind.in/ai-ethics-board-can-it-be-achieved/) (Analytics India)
- [Businesses can now Test AI for Bias, Transparency, and Explainability](https://www.ai-business.com/blogs/brightness-test-ai-bias-transparency-explainability/) (AI Business)
- [Computer says no: why making AIs fair, accountable and transparent is crucial](https://www.theguardian.com/technology/2018/jul/06/computer-says-no-why-mak) (The Guardian)
- [How to make artificial intelligence more ethical and transparent](https://www.bbva.com/en/how-to-make-artificial-intelligence-more-ethical-and-transparent/) (BBVA)
- [Don't make AI artificially stupid in the name of transparency](https://www.wired.com/2017/04/dont-make-ai-artificially-stupid-name-transparency/) (Wired)

### Section 3: How is AI Developed?

Some simple AI applications can be used "off the shelf". However, while some AI applications are inexpensive or free at small scale, they can become very expensive on a large scale (Weiner, 2018). Applications will often need to be customized and further developed to be useful beyond simple tasks. Customization typically consists of finding a base AI application (or model) and data source, training the application to do customized tasks, tuning the application to assure desired results, then deploying and monitoring the application (see an example in Figure 4). This process typically requires programming skills.
An AI developer requires a modern AI stack which consists of an infrastructure and a developer environment. The infrastructure consists of tools, platforms and techniques used to run, build, train, and create algorithms. The developer environment are tools that assist in developing code to bring out AI capabilities, such as libraries, integrated development environments (IDE), data visualization, and workflow. At one time, a developer needed to write code to build and train AI, however there are now machine learning platforms, libraries, and data platforms readily available as software platforms.

Various consumption models now exist to assist AI development. While the AI stack can be housed completely on premises (all parts of the stack are in-house), parts of the stack (infrastructure, algorithms, computing resources, or cognitive services) can be outsourced.

- In the **AI as a service (AI-aaS)** model, the infrastructure services are outsourced (e.g., Google Cloud ML Engine, Amazon ML).
- In the **commodity AI-aaS** model, algorithms are outsourced (e.g., Watson, Microsoft Cognitive Services) (Weiner, 2018)
- In **managed AI-aaS**, computing resources are automatically allocated and managed as the model requires (e.g., Google Cloud AutoML, Amazon SageMaker, Azure ML Studio).
- In **cognition-aaS**, the advanced cognitive capabilities are available as a service (e.g., Amazon Rekognition Video, Google Vision, Azure Compute Vision).

Cognitive computing capabilities available as a service is expected to double approximately every year (Subramanian, 2018). Another option is to engage third-party applied AI companies that can provide a broader and more customized range of vertical AI services (Weiner, 2018).

A simple example of AI customization using a linear model is teaching an AI application to detect the difference between wine and beer. The steps leading up to deployment might include

**Building**
- choosing differentiating data features (e.g., color and percent alcohol content),
- gathering training and test data (e.g., typical color and alcohol content for each drink type),
- preparing data (e.g., loading data and preparing it for machine learning training),
- choosing a model (e.g., linear model) with adjustable parameters,
- defining an objective function to evaluate the desirability of outcomes based on chosen parameters,

**Training**
- training the model to improve predictions and maximize the objective function,
- evaluating results,

**Tuning**
- tuning parameters, and
- testing predictions. (G, 2017; NTSC, 2016).

**Deploying**

Data and data management will be front and center in an AI world. *Digitalist Magazine* predicted that we’ll continue to see an evolution of how data is stored, managed and governed. AI teams will need
to access and manipulate data to build AI models and this work should be preserved so the next AI team can find and reuse it with ease (Poskitt, 2019, Microsoft, n.d.-c).

What Skills are Needed to Develop Custom AI?
Programming and math skills are needed to develop custom AI. These skills can be developed in-house with current employees who have programming, statistics and data management backgrounds or new employees may be hired with these backgrounds. Table 5 shows an example of a training blueprint that could be used to develop AI customization skills with current staff. Finding creative ways to gain AI skills, like taking advantage of opportunities for temporary assignments (whether by sending an employee to another project or borrowing a visiting technologist from other areas) may provide additional training and skills. Additionally, organizations and managers may benefit from resources like Microsoft's free online Al School.

An AI skills shortage is currently a major challenge for organizations implementing AI (Gartner, 2019). Additionally, AI implementation has a significant learning curve and people are an important ingredient in successful implementation. There will be a need for AI savvy users, programmers, managers, and problem solvers who can think creatively using AI in ecosystems across organizational silos to boost digital process efficiency and quality. To this end, Publicis Group created an AI employee assistant named Marcel to share its vast amount of unstructured data among employees (Microsoft, n.d.-b) A 2018 webinar for MIT Sloan Management Review indicated that people will be such an important ingredient for the success of AI that we may begin to see Chief Human Resource Officers (CHRO) in companies using AI (Bughin and Michelman, 2018). Developing skills in-house is one way we can prepare to address the AI skills shortage challenge.

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<tr>
<th>Learn Programming Languages</th>
<th>Use Libraries with Python API</th>
<th>Read and Modify Other’s Code</th>
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<th>Practice!</th>
<th>Brush up on Math Skills</th>
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<td>Keras, Apache MXNet with Gluon</td>
<td>Fully connected networks</td>
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<td>Learning Python:</td>
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*Tensorflow is a high-level library and Caffe2, Caffe, and PyTorch are deep learning libraries.*

*Udacity, CodeAcademy, Khan Academy, Statistics and probabilities, Linear algebra, matrices, Derivatives / Differential Calculus, Multivariable Calculus.*
Adapted from 10 steps on the road to Deep Learning (2018) and Artificial intelligence 101: How to get started (2017).

*Author notes that Theano is going into maintenance, Tensorflow is low-level, frustrating, and hard to learn – developer went to FB (Caffe2 project).

References


