An Artificial Intelligence Primer for Developers

Computer scientists have been pursuing Artificial Intelligence (AI) for over 60 years. While the term has meant different things over the decades, recent advances have brought us closer to achieving machine intelligence than ever before.

Developers who are just learning about AI and machine learning will have many questions, from “What can I do with AI?” or “Why would AI be a programming solution?” to “What is necessary to say my program is learning?” and “What level of machine interaction is necessary to make it seem intelligent?” or even “Does my program need to appear intelligent to be intelligent?”

Introduction

Artificial intelligence (AI) is both a problem and a solution. It is a rapidly growing field of inquiry that could solve deep complex problems such as medical diagnosis or undersea mining. It can also give us fun solutions such as valued competition in video games. Developers not only develop the intelligence but also help mold it to solve problems.

Artificial Intelligence (AI) in the World

AI is a truly massive revolution in computing. It is fundamental in all kinds of computing fields, such as gaming, robotics, medicine, transportation, and Internet of Things (IoT). And it’s happening at a depth that will transform society in much the same ways as the industrial revolution, the technical revolution, and the digital revolution altered every aspect of daily life.

Even though AI has been a part of computing for many decades, the prospects of what AI can do, of what we can do with AI, still have us at the beginning of the field. Here are a few examples of what it will enable as the technology matures.

AI will accelerate how we answer large-scale problems that would otherwise take months, years, or decades to resolve. Medical treatments such as drugs or other interventions will be personalized at the level of an individual’s DNA. Intelligent assistants will forestall mistakes and open new opportunities by providing real-time guidance about the world around us. In commerce, it will be much easier to detect—and in some cases even eliminate—fraud.

AI will unleash new scientific discovery. No longer restricted by human biology and cognitive methods, scientists will be able to mine new insights in the realms of the deep sea and space, the animal and insect kingdoms, particle physics, mysteries of the brain, and more.

AI will augment our human capabilities. A new symbiosis between human and machine will expand our capacity, so that medical diagnoses can be more precise, legal counsel can encompass the entire history of case law, and other services will achieve unprecedented levels of accuracy.

AI will remove the burden of tedious or dangerous tasks, such as driving, firefighting, and mining. We are already seeing the early stages of this field with autonomous cars.

Artificial Intelligence Improved with Intel

At Intel, the ideas of AI are not tied to levels of capability. Rather than seeing AI as the end result, the ability to define human understanding, Intel sees AI as a computational tool for solving human problems. Rather than defining what it takes for an intelligence to be human, or what minimum tests must be passed to attain a threshold of "intelligence," AI runs in a cycle of Sense, Reason, Act, Adapt. The input (Sense) is analyzed and a result formulated (Reason). Based on this, the proper action is chosen (Act) and based on results, the input is then used to improve how input is gathered and selected, and the calculations made on the input is improved (Adapt).

Rather than go into the different ways to determine if a machine has a human level of intelligence, the four-step cycle used at Intel is all you need to guide your programming to create an AI solution. In addition to the methodology, Intel, of course, offers computer technologies that make the complex calculations necessary to make AI run faster.

What is Artificial Intelligence?

It may be good to call AI a solution, but the question still hides in the background: How do we know when it's intelligent? A number of tests have been developed to "tell" if an AI's ability to exhibit intelligent behavior is indistinguishable from a human. The most famous of these is the Turing Test. In daily use cases, the determination of whether or not an intelligence is equivalent to our own is an academic point.

While this is important to understand what intelligence means, there is a more practical consumer application regarding what AI is. If the AI is the solution to our problem then that is what is important. So when you consider how AI is a powerful tool, no matter the technique we might use to create and harness AI or the scope to which AI is employed, the intelligence must be able to **sense**, **reason**, and **act**, then **adapt** based on experience.

Sensing requires the AI to identify and/or recognize meaningful concepts or objects in the midst of vast pools of data. Is this a tumor or normal tissue? Is this a stoplight or a neon sign, and if it's a stoplight, is it green, yellow, or red?

Reasoning requires that the AI understands a larger context and make a plan to achieve a goal. If the goal is to make a differential diagnosis, then the machine must consider the patient's reported symptoms, DNA profile, medical history, and environmental influence in addition to the findings from imaging and lab tests. If the goal is to avoid a vehicle collision, the AI must calculate the likelihood of a crash based on vehicle behaviors, proximity, speed, and road conditions.

Acting means that the AI either recommends or directly initiates the best course of action to maximize the desired outcome. Based on a diagnosis, it may recommend or perform a treatment protocol. Based on vehicle and traffic analyses, it may brake, accelerate, or prepare safety mechanisms.

Finally, we must be able to adapt algorithms (both within the AI and as part of the computing system the AI resides in) at each phase based on experience, retraining them to be ever more intelligent in their inferences. Healthcare algorithms should be re-trained to detect disease with more accuracy, better grasp context, and improve treatment based on previous outcomes. Autonomous vehicle algorithms should be re-trained to recognize more blind spots, factor new variables into the context, and adjust actions based on previous incidents.

Today, the greatest ability lies in the "sense" phase, while progress continues to be made in both reasoning and action. The majority of techniques used involve mathematical or statistical algorithms, including regression, decision trees, graph theory, classification, clustering, and many more. However, an emerging algorithm in deep learning is growing rapidly, harnessing deep neural networks that simulate the basic function of neurons in the human brain.

The Market for Artificial Intelligence

It might be easy to see that there are huge areas that benefit from AI. Cancer research, space exploration, and self-driving vehicles are a few fields. But they seem so overwhelming that a person getting started in AI might feel like they can't contribute let alone make a difference. But AI is used in places you don't expect, which is why it's such a broad, useful tool. You can work on non-player characters in games, on predictive route-finding applications, even sheepherding robots. There is no limit to the possibilities of AI.

Business Interest in Artificial Intelligence

In previous years, businesses have not been as willing to invest in AI because there have been large research costs involved. But this has changed. Business leaders, from CTOs to CFOs to CEOs, recognize the utility and even necessity of AI as a solution.

In 2014, there was more than USD 300 million invested into AI startups, which was up 20 times from USD 15 million in 2010[1], and the global robotics and AI markets are estimated to grow to USD 153 billion by 2020. The market for AI systems in healthcare alone is estimated to grow from USD 633 million in 2014 to more than USD 6 billion by 2021[1]; and by 2020, autonomous software will participate in 5 percent of all economic transactions[2]. Companies are putting more and more effort into AI R&D and products; your input will only help.

But What Field Can I Work In?

It's understandable to see the amount of interest in AI and how opportunities are growing. But what kinds of fields are actually using AI? Maybe you aren't interested in gaming, and maybe you want to grow in a field that isn't in academic research. What else can you do? Here is a small list of fields and how AI is growing in them:

Healthcare

- Image analysis – Medical startups are pursuing technology that will help read X-rays, MRIs, CAT scans, and more.
- Dulight* – This is a wearable that identifies food, money, and more for the visually impaired.

Automotive

- Self-driving cars – AI helps autonomous cars recognize road signs, people, and other vehicles.
- Infotainment – Improved speech recognition helps drivers better engage with music, maps, and more.

Industrial

- Repairs and maintenance – AI systems can anticipate repairs and improve preventative maintenance.

- Precision agriculture – AI can help improve food production with efficient fertilization methods and time-to-market.
- Sales and time-to-market – AI can predict which products will be sold faster or in more volumes in different areas at different times of year, and which times it would be more efficient to keep them in stock or have them drop-shipped to customers.

Sports

- Performance optimization – AI systems can help coach athletes' conditioning and nutrition, and improve their skills.
- Injury prevention – Equipment design and improved play calling, and even predictive rules needs for player safety.

Even from this brief, incomplete list you can see how many opportunities are available. AI can be used to improve lives in so many ways. How, is up to you.

Artificial Intelligence – Driven by Intel

Intel is not merely invested in the growth of AI, we are committed to fueling the AI revolution. AI is a top priority for Intel and we're committed to leading the charge, both through our own R&D and through acquisitions. Our innovation and integration of capabilities into the CPU, driven by Moore's Law, will continue to deliver the best possible results for performance, efficiency, density, and cost effectiveness. Also, we have a long history of successfully executing technology shifts driven by groundbreaking technologies, including breakthroughs in memory, graphics, I/O, and wireless, and we have in place today the toolbox and unique capabilities needed for the transformation to AI.

First, Intel is compressing the AI innovation cycle in bold new ways. We've acquired the best deep-learning talent and technology on the planet, Nervana*, which will not only accelerate AI data ingestion and model building, but also deliver a substantial training performance versus GPU next year through integrating the Nervana technology into the CPU.

Second, as AI becomes pervasive in applications from datacenters to the IoT, Intel has the unique, complete portfolio to deliver end-to-end AI solutions.

Finally, Intel has the experience of successfully leading past transformations from the client/server model, to server virtualization, to the rise of the cloud.

Intel can offer crucial technologies to drive the AI revolution, but we must work together as an industry – and as a society – to achieve the ultimate potential of AI. To that end, Intel leads the charge for open data exchanges and initiatives, easier-to-use tools, training to broaden the talent pool, and equal access to intelligent technology. We entered a partnership with Data.gov in an open data initiative. An open car collaboration with BMW will reduce duplicated effort and accelerate innovation, with society playing a key role.

Intel is committed to compressing the innovation cycle from conception to deployment of ever more intelligent, robust, and cooperative AI agents, through breakthroughs in data ingestion and the building, training, and deployment of models. These AI capabilities will be driven by a portfolio of powerful technology solutions.

Conclusion

AI is rapidly transforming industries and is an increasingly important source of competitive advantage. To maintain a leadership position in your field, this is the best time to begin integrating AI into your products, services, and your business processes. Visit the Intel Software Developer Zone for Artificial Intelligence: https://software.intel.com/en-us/machine-learning https://www.intel.com/ai to get started today.

Notes

1) Clark, Jack. "I'll Be Back: The Return of Artificial Intelligence," Bloomberg Technology, February 2015. http://www.bloomberg.com/news/articles/2015-02-03/i-ll-be-back-the-return-of-artificial-intelligence

2) Gartner Press Release. "Gartner Reveals Top Predictions for IT Organizations and Users for 2016 and Beyond," October 6, 2015. http://gartner.com/newsroom/id/3143718

Notices