

# TOP 10 QUESTIONS ABOUT QUANTUM COMPUTING CURRICULUM

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#### ONE

### **Q** : Is the IBM Quantum Experience an actual quantum computer or a software emulation?

A : The IBM Quantum Experience is absolutely a real quantum computer. It is not a simulation of a quantum computer. It is quantum computing hardware. We will write a program that we then send to this cloud quantum computer at IBM and they will implement it there on their quantum computer and send the answer back.

#### TWO

#### **Q** : Are the course participants going to implement on the IBM quantum computer?

A : That's right. Every learner will have the opportunity to write a quantum computer software code that implements a quantum algorithm. It will be sent to IBM. They run it on their cloud computer and send the results back.

#### THREE

### **Q** : What prior physics or mathematical knowledge is required to be successful in the course?

A : We wanted to develop a course that started really from the basics so it's helpful if you've had a course in quantum mechanics and linear algebra at some point. And it's also helpful if you've programmed a computer in some way before. But the idea is that we really start from the beginning and go forward.

#### FOUR

## **Q** : Could you please explain near term use of a quantum computer consisting of 100 qubits? What problem that we can solve?

A : That's an outstanding question. What can we do with quantum computers at a small scale level? I think the first applications are going to be in the domain of quantum simulation where we use a quantum computer to simulate a quantum system.

Questions were originally posed to and answered by Dr. Oliver via live webcast on 3/28/18. The questions and responses have been transcribed and edited for clarity. Photos courtesy of Connie Zhou for IBM



#### FIVE

## **Q** : Is it driven to gate model, or will adiabatic quantum computers be covered and how to map problems to this specific hardware?

A : We will be discussing both gate model and adiabatic quantum computing or quantum annealing. The focus of the course is going to be on gate model but we will have discussions on quantum annealing and will touch on how to do mapping between a particular problem and implementing it on an actual quantum annealer. But the focus of the course is on digital and analog quantum simulation as well as gate model universal quantum computing.

#### SIX

## **Q** : Will the course touch upon QKD and its implementation with the IBM Quantum platform?

A : We will touch upon quantum key distribution (QKD). That's quantum communication protocol. We'll look at a couple different types of QKD as well as random number generation using quantum mechanics. But we won't implement it on the IBM Quantum Experience. The Quantum Experience is solely for quantum computing and not for quantum communication.

#### SEVEN

## **Q** : Is there any probable applicability of quantum computing in Artificial Intelligence or Machine Learning?

A : I think so. People are searching for applications in the AI and ML space and there's absolutely a lot of excitement in this area and a lot of research going on. And I can add that there's the concept of using a quantum computer to do AI and ML, but there's also using classical computing and AI to do quantum better. I think it goes in both directions.

#### NINE

#### **Q** : Are these courses helpful to those who do not have programming/tech background and really want to focus on the development of applications of quantum computing in the real world?

A : Course 1 is at a great level for someone who doesn't necessarily have a programming or tech background but wants to learn what quantum computing is. Throughout the courses, the topics become more in depth and more technical in nature. In terms of trying to develop real world applications, it takes a village, right? So you're going to have to have people that focus on science and technology but there's also a very important business aspect to this. And we do try to touch throughout the courses on the business, the engineering, the science, and the technology. We do a 360 degree view of these applications and hopefully you find something useful to you.

#### EIGHT

### **Q** : What types of job opportunities would be available to those who take this course?

A : I think having knowledge of quantum information will be very helpful. This will give you not just a background (that's course 1) but an in-depth look at what are the issues involved in building a quantum computer or quantum communications system and what are the current challenges. This will educate you on the entire scope of quantum information science and technology.

#### TEN

#### Q : Are there any estimation as to when quantum computing becomes a major force in the industry? Are we 5, 10, or 15 years away from prevalent use of QC?

A : That's a great question and that's why you should be taking these courses so you can make that estimation for yourself. I've had numerous people ask me that question, from business, from government, from academia – when are we going to have a quantum computer? There's no clear answer to that. We needed to develop quantum curriculum like this so people can educate themselves on what are the issues and then make a business decision on when do I get in.

MIT xPRO's Quantum Computing curriculum are four online courses divided into two programs: *Fundamentals of Quantum Computing* and *Quantum Computing Realities.*