



**POLKADOT
BLOCKCHAIN
ACADEMY WITH
DR. GAVIN WOOD**

Syllabus

Polkadot Blockchain Academy

Cambridge University
Corpus Christi College
July-August 2022

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Instructors

Module 1: Cryptography

Dr. Gav Wood, Founder/Inventor Polkadot, Co-founder Ethereum, Founder Parity Technologies, Founder Web3 Foundation
[Alistair Stewart](#), Lead Researcher, Web3 Foundation

Module 2: Interdisciplinary Concepts in Blockchain

[Jonas Gehrlein](#), Research Scientist, Web3 Foundation
[Alistair Stewart](#), Lead Researcher, Web3 Foundation
[Alfonso Cevallos](#), Blockchain Researcher, Web3 Foundation

Module 3: Blockchain and Consensus

[Joe Petrowksi](#), Technical Integrations Lead, Web3 Foundation
[Emre Surmeli](#), Technical Educator, Web3 Foundation
[Joshy Orndorff](#), Teaching Assistant, Polkadot Blockchain Academy

Module 4: Substrate

[Shawn Tabrizi](#), Runtime Engineering Lead at Parity Technologies
[Kian Paimani](#), Rust/Blockchain Developer, Parity Technologies
[Émeric Chevalier](#), Software Engineer at Parity Technologies
[André Silva](#), Software Engineer, Parity Technologies

Module 5: Polkadot

[Bastian \(Basti\) Köcher](#), Software Engineer, Parity Technologies
[Robert Klotzner](#), Software Engineer, Parity Technologies
[Bernhard Purstner](#), Former Software Engineer, Parity Technologies

Module 6: Pallets and FRAME

[Shawn Tabrizi](#), Runtime Engineering Lead at Parity Technologies
[Kian Paimani](#), Rust/Blockchain Developer, Parity Technologies
[Michael \(Michi\) Müller](#), Core Developer, Parity Technologies
[Alexander Theißen](#), Smart Contracts Execution Lead, Parity Technologies
[Ricardo Rius](#), Senior Solutions Engineer, Parity Technologies

Module 7: XCM

Dr. Gav Wood, Founder/Inventor Polkadot, Co-founder Ethereum, Founder Parity Technologies, Founder Web3 Foundation
[Keith Yeung](#), Core Runtime Developer, Parity Technologies

Teaching Assistants

Dan Shields, Developer Experience Engineer, Parity Technologies
Contact details: @dan.shields:matrix.parity.io on Matrix/Element

Sacha Lansky, Developer Advocate, Parity Technologies
Contact details: @sacha-l:matrix.parity.io on Matrix/Element

Josh Orndorff, Software Engineer,
Contact details: @joshyorndorff:matrix.org on Matrix/Element

Course Description

The Polkadot Blockchain Academy is a comprehensive course covering both the conceptual underpinnings and the hands-on application of Blockchain technology, using the Polkadot and Substrate blockchain ecosystem as the foundation for blockchain development. Learners will be introduced to core concepts in economics, government and computer science as they apply to Blockchain development, and will build blockchains and parachains using the Substrate, Pallets and FRAME frameworks.

Prerequisite

All learners have been selected to the Polkadot Blockchain Academy through a rigorous selection process, which includes a review of each learner's engineering history and systems engineering experience and an entrance interview. Moreover, every learner must have demonstrated a baseline understanding of the Rust programming language, which may include attendance at a Rust pre-course or completion of a Rust Exam.

Learning Outcomes

By the end of the Polkadot Blockchain Academy, learners will be able to:

- Explain the conceptual underpinnings of blockchain technology
- Apply economic, political and computer science concepts to blockchain decisions
- Design blockchains and parachains using the Substrate framework
- Use pallets and FRAME to expedite Blockchain development
- Apply systems engineering principles to blockchain development
- Use XCM for cross-consensus messaging
- Work as a blockchain developer in the Polkadot ecosystem

Course Format

Each day of the Polkadot Blockchain Academy, there will be a **morning** and an **afternoon** session of approximately 3 hours each.

These sessions will be a combination of lectures, seminars and demonstrations from top Blockchain engineers as well as hands-on in-class application and practice activities.

Every Sunday, there will be a 'deep dive' session with an expert on a particular topic of interest. These sessions are optional, but recommended.

Course Assignments and Grading

The final grade for the Blockchain Academy will be calculated using this formula:

Assignment Weights	Percent
Attendance	10%
Participation in In-Class Projects	20%
Midterm: Group Assignment	20%
Final Exam/Technical Assessment	50%
Total	100%

Grading Scale

95% - 100% = **A+**
90% - 94.9% = **A**
85% - 89.9% = **B+**
80% - 84.9% = **B**
75% - 79.9% = **C+**
70% - 74.9% = **C**
60% - 69.9% = **D**
0% - 59.9% = **F**

- Attendees receiving an A grade will receive a certificate of completion *with distinction*.
- Attendees receiving a C grade or higher will receive a certificate of completion.
- Attendees receiving a D grade will be offered a certificate pending the final evaluation.
- Attendees receiving an F grade will not receive a certificate.

Attendance

It is expected that learners attend all lectures and classes throughout the Polkadot Blockchain Academy with the exception of Sunday seminars, which are optional.

Although exceptions will be made for medical reasons or other emergencies, learners should plan on attending all class sessions. If a learner misses more than 2 of the 20 class days, his or her final grade will be reduced by 10%, which will threaten their ability to earn the final certification.

Take Home Assignments

There will be a small number of ‘take-home assignments’ over the course of the Polkadot Blockchain Academy. These assignments are designed to sharpen your skills and provide practice opportunities to extend your learning beyond the scope of the course.

Take-home projects will not be graded on an individual basis, but will support learners’ understanding of the material and are recommended.

In-Class Projects

There will be a number of in-class projects that learners are expected to participate in during the course of the Blockchain Academy.

In-class projects may be designed for individuals, pairs or small groups of learners, and are designed to help learners practice the application of core concepts and skills.

In-class projects will not be graded on an individual basis. However, a consistent failure to work on or contribute to in-class assignments will result in **a reduction of up to 30%** in the final grade.

Midterm

The 'Midterm' Exam will be due after Module 3. It will serve as a summative assessment for the conceptual sections of the course (Cryptography, Economics, Government and Blockchain).

You will be asked to analyse and dissect the conceptual components of a blockchain project.

This will be a *group* activity, and all members of the team will receive the same grade; its completion will constitute **20%** of your final grade.

Final Exam

The Final Examination will constitute a coding assignment in which you will be asked to complete one choice of prompts using the tools of the Polkadot ecosystem (Rust, Substrate, FRAME, Pallets). You will receive the final examination one week before the end of the Academy, and are expected to complete your assignment individually.

On the final days of the Academy, you will be asked to sit for an **oral portion of the examination** with a Parity developer to discuss your work throughout the course, including the final assignment.

The **Final Exam (coding and oral exam) constitutes 50% of the final grade** in the course.

Feedback

As you know this is the first cohort of the Polkadot Blockchain Academy. Our intention is to provide the best training possible to talented developers in Blockchain, Substrate and Polkadot. Some of our best engineers and some founding members of Parity Technologies and of the Web3 Foundation will deliver this program. We would like to invite you to contribute by sharing feedback on the course content, learning activities and social activities, and anything you think we could improve to make this program the most valuable. Feel free to share your feedback during the feedback survey or to your TAs, instructors or any member of the staff.

Course Policies and Procedures

Seeking Support

For Academic Support:

Your first line of academic support will be the on-site TAs (teaching assistants), who will be present throughout the Academy. You should also feel free to ask questions of instructors in class, or to follow up with them after class for additional support.

You will also be invited to participate in dedicated Q&A sessions with TAs and instructors which will allow for extra time to ask questions.

There are also additional resources available - glossaries, resource lists, and documentation, to support your academic journey.

For Support with Housing/Food/Accommodations and other Activities

Contact [Alexandra](#), Operations and Community Manager

In Case of Illness or Other Emergencies

COVID-19: If you suspect that you may be experiencing symptoms of COVID-19 or have been exposed to someone who has been tested positive to COVID-19, please isolate yourself in your room either on the College campus or hotel and contact [Alexandra](#). We will get you a test and/or connected with medical services.

In case of other illnesses, please contact us so that we can assist you if needed.

Attendance Policy

In order to graduate from the Academy you must ensure that you attend, and are punctual in **attending 18 of the 20 lectures and classes and non-optional activities** taking place during the Academy.

If you are absent through illness, you must inform us and provide proof (e.g. a note from a medical professional) as soon as possible, and absences for any other reason are subject to our prior written consent.

Academic Integrity

In order to graduate from the Academy you must complete all course requirements in order to graduate and/or obtain graded certification from the Academy; and only submit work that is your own, and that is not plagiarised or copied from a third party in any way whatsoever.

Behaviour Expectations

In order to graduate from the Academy you must behave in a respectful manner at all times to all students, teaching staff and employees of Cambridge University, the Academy and Parity, and to represent Parity and the Academy to the best of your abilities (commensurate with enrolment in a first-class educational programme).

We are committed to making this program the best possible, with high quality content, learning activities and a dedicated teaching staff. We do ask that you engage with the course material for your own learning only and do not distribute the material, either in full or partially, externally.

Acknowledgement and Authorization

A photo crew will take pictures and record videos that might be used for our course audit and internal education effort, and for marketing purposes in the future.

We have a list of students who have indicated that they do not wish to be filmed or photographed. The crew will be informed about students who have opted out. We'll also put up clear signs when we're recording so you can always step aside.

Course Schedule

Date	Module	Lessons
July 11-13	Cryptography of Blockchain	<ul style="list-style-type: none"> • Introduction to Cryptography • Digital Signatures • Exotic Primitives • Hashes • Hash-Based Data Structures
July 14-15	Interdisciplinary Concepts in Blockchain: Economics & Government	<ul style="list-style-type: none"> • Economic Concepts in Blockchain • Game Theory • Price Discovery Methods/Auctions • Collective Decision Making • Voting Methods
July 18-20	Blockchain and Consensus Systems	<ul style="list-style-type: none"> • Blockchain Technology • State Machines • Consensus Systems • Threat Models • Application Stack • Light Clients and SPV • Fees, Bridges and Ordering
July 20th	Midterm Exam Due	
July 21-25	Substrate	<ul style="list-style-type: none"> • Block Anatomy and Concepts • Transaction Queue • Block Builder • Host/Runtime Interface • Merklized Storage • Consensus, Block Authoring and Finality • Networking and RPC
July 26- 28	Polkadot	<ul style="list-style-type: none"> • Polkadot Architecture • Polkadot Governance • Cumulus • Hashing in Polkadot • Parachain Architecture • Parachain Security • Parachain Logic • Networking in Polkadot • Authority Selection
	Final Exam Begins	<i>You will receive your final exam instructions on the weekend of July 29th. You will have the weekend, evenings and some class time on the final week to complete the exam.</i>
July 29- Aug 3	Pallets and FRAME	<ul style="list-style-type: none"> • Pallet Anatomy • Staking • Smart Contracts • Balances and Currency Traits • Connecting Pallets • Weights and Benchmarking

Aug 4-5	XCM (Cross-Consensus Messaging)	<ul style="list-style-type: none"> • XCM Logic • Locations-in-Consensus • Assets in XCM • Wildcards and Asset Filters
Aug 5	Final Exam Due and Oral Evaluations	




Recommended Resources Per Module

We recommend reviewing these resources to supplement your understanding of each module.




Module 1: Cryptography of Blockchain

Resource	Format
 Lecture 1: Introduction to Cryptography by Christof Paar	Video
 Lecture 16: Introduction to Elliptic Curves by Christof Paar	Video
 Lecture 18: Digital Signatures and Security Services by Christof Paar	Video
 Lecture 20: Hash Functions by Christof Paar	Video

Module 2: Interdisciplinary Concepts in Blockchain

Resource	Format
Survey on Applications of Game Theory in Blockchain	Reading
 Introduction to Cryptoeconomics - Vitalik Buterin	Video
 Cryptoeconomics In 30 Minutes by Vitalik Buterin (Devcon5)	Video
 Bitcoin is the Schelling Point of Money Game Theory, Network Effects & Li...	Video




Module 3: Blockchain and Consensus Systems

Resource	Format
 Polkadot: Are You Ready to Start Building?	Video
 Understand the Blockchain in Two Minutes	Video
 Parity and Friends: Substrate Lite & Subsocial	Video
Consensus Mechanisms in Blockchain	Reading




Module 4: Substrate

Resource	Format
Substrate Developer's Hub	Documentation
Substrate Developers' Documentation	Documentation
Substrate Tutorials	Tutorials
Substrate Rust Docs	Documentation
Substrate Glossary	Documentation
 Sub0 Online: Keynote, Gavin Wood, Parity Technologies	Video
 Substrate: A Rustic Vision for Polkadot by Gavin Wood at Web3 Sum...	Video
 Substrate: One Year Later by Shawn Tabrizi at Web3 Summit 2019	Video
 Rob Habermeier presents Parity Substrate: the foundation for block...	Video
 Sub0 Online: Building Parachains With Substrate	Video

Module 5: Polkadot

Resource	Format
Polkadot.js Git	Repo
Polkadot.js Tools	Repo
Polkadot.js Documentation	Documentation
Polkadot Support Knowledge Base	Documentation
Polkadot Parachain Implementer's Guide	Tutorial
Original Polkadot Whitepaper	Reading
Overview of Polkadot and Its Design Considerations	Reading
An Updated Overview of Polkadot	Reading
 Polkadot Behind the Code, Episode 1: The Idea, featuring Gavin Wood	Video
 Polkadot Behind the Code, Episode 2: The Build, featuring Gavin Wo...	Video
 Polkadot Behind the Code, Episode 3: The Ecosystem, featuring Gav...	Video
Polkadot Blog: Consensus <ul style="list-style-type: none">• 1 (overview)• 2 (Grandpa)• 3 (BABE)• 4 (Security)	Reading

Module 6: Pallets and FRAME

Resource	Format
FRAME and Pallets: Developer's Hub	Docs
FRAME Repository	Repo
FRAME Github.io	Docs
 Sub0 Online: Innovating with FRAME	Video
 Substrate Seminar: Pallet Fundamentals and Ways to Build With Them	Video
 Intro to Substrate codebase and FRAME pallet deep-dive with Joe Petr...	Video

Module 7: XCM (Cross-Consensus Messaging)

Resource	Format
XCM Part I: The Cross-Chain Message Format	Reading
XCM Part II: Versioning and Compatibility	Reading
XCM Part III: Execution and Error Management	Reading
XCM Github	Repo
Polkadot's XCM with Rob Habermeier	Podcast
XCM Stack Exchange (Keith Yeung Answers)	Readings