Solidity and Smart Contract Development

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Overview & Syllabus

Syllabus

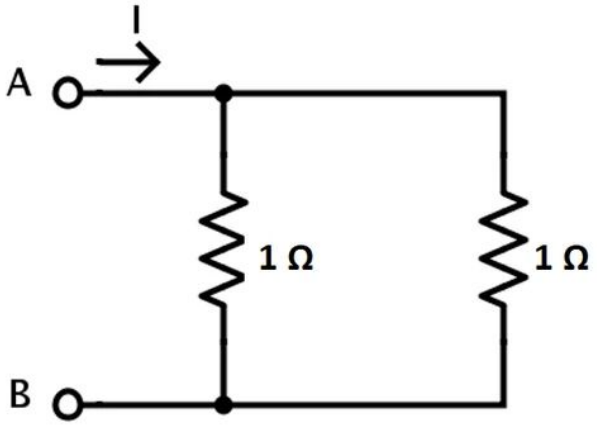
Lecture 1 - History and Architecture of Blockchain
Lecture 2 - Introduction to Solidity and Remix
Lecture 3 - Game Simulation: Blockchain Architectural Evaluation
Lecture 4 - Advanced Contract Concepts: Build your own Blockchain
Lecture 5 - Contract interactions and oracles
Lecture 6 - Digital Currencies: Central Bank and Money
Lecture 7 - Digital Currencies: CBDCs
Lecture 8 - Smart Contract vulnerabilities and testing
Lecture 9 - Blockchain in Space: Supply chain for space components
Lecture 10 - Blockchain in Space: NFT Digital Twins and Data Storage
Lecture 11 - DAOs and Governance
Lecture 12 - Ethereum Memory and Gas Economy

Grading

- **Github refresh and introductory Solidity programming - 10%**
- **Blockchain as Smart Contract - 20%**
  - **Networking - Node discovery, transaction propagation**
  - **Consensys - Design your own consensys protocol**
- **Digital Euro - 15%**
- **NFT in Space - 15%**
- **Final Project: Onchain DAO - 25%**
  - A full onchain DAO
- **In class presentation - 15 %**
  - Weekly on Monday
  - Graded by professor (50%) and a class DAO (50%)

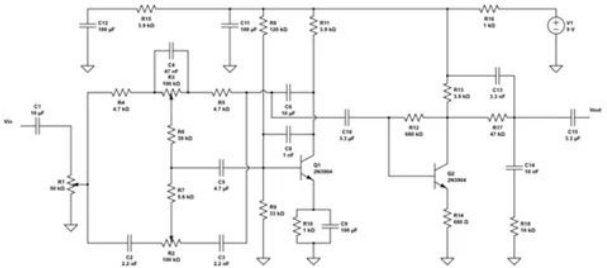
This course is heavily application based!

IN LECTURE...



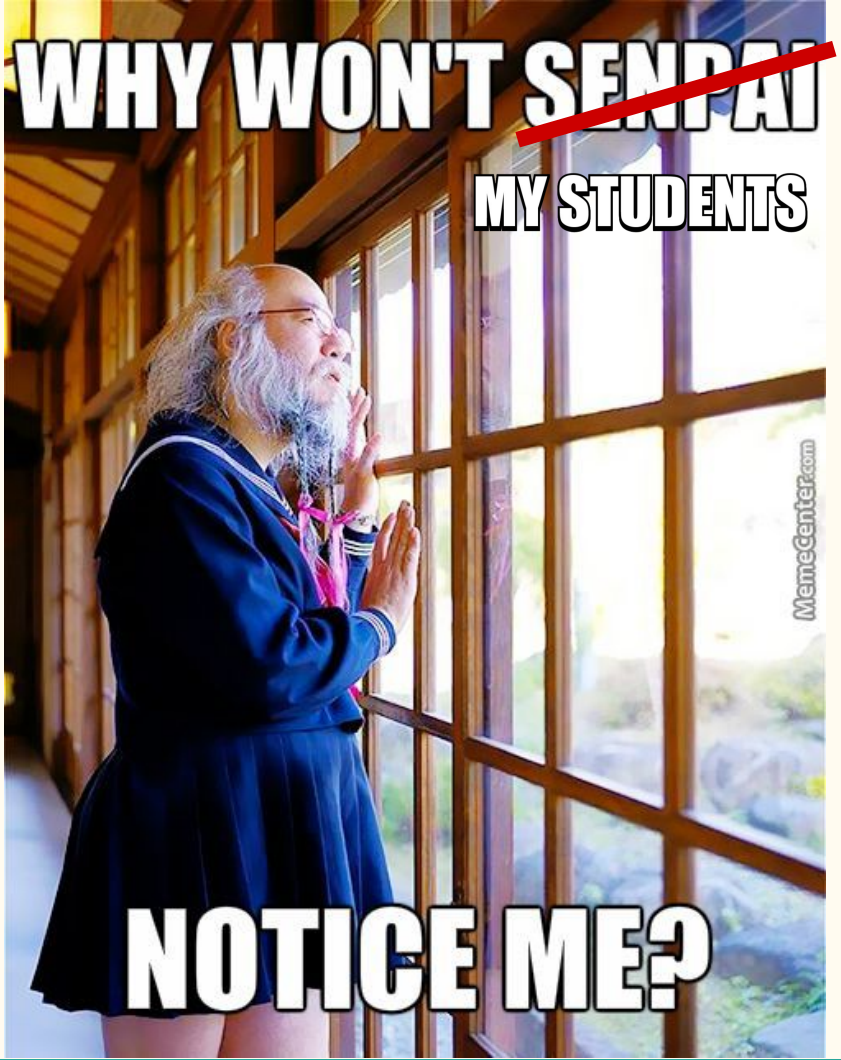
Compute R_{eq} between points A and B

THE FIRST HW PROBLEM



Derive an expression for the electric current through R_{55} at time t, as a function of C_3, C_{12}, V_6, and the speed of light.

(Speed of light = 1.8e+12 furlongs/fortnight)



This class is fast paced.

When stuck on a project, talk to the professor:

Email - Formal requests, discussions
Discord - On demand problem solving

You can also talk to AI:

Technical: Remix Co-pilot
Theoretical: ChatGPT, Claude.ai

AI policy

- What is a rational AI agent? Develop your AI literacy:
  - Has some input - Prompt correctly
  - Produces an output - Be able to evaluate the correctness
  - Maximizes some expected value - Understand the internals, aka. limitations.
- Academic honesty
  - You may use AI but citations necessary!
  - Always match citation style and follow publication guidelines. Check here.
  - Same applies for code. citation as a comment in the code.
  - Failure to cite AI usage will be considered an academic violation!

Be able to evaluate the AI, not blindly trust it

Bonus Point

Look out for black slides!

Answering correctly gives +0,5 point (out of 20) to the current homework grade.

Many other bonus points within projects.

Optional bonus activities. Eg. NFT Paris.

Attend a Hackathon: +1% on final grade, win it: +5% on final grade

Presentation Topics

- **21 January : Bitcoin and Open Source**
  - Satoshi's Whitepaper: here
  - What system is Satoshi trying to build? What technical challenges does this system address?
  - What are BIPs? Walkthrough of the BIP repository: here
  - Evaluate the BIP Github community. Major influential powers? Future development outlook?
- **26 January: Properties of Ethereum**
  - Vitalik's Whitepaper: here
  - Compare and contrast two properties of Ethereum vs Bitcoin (improvements presented in paper)
  - Why is Ethereum considered Turing Complete? How does its fee structure support this characteristic?
- **2 February: Project Mariana (CBDC & AMMs)**
  - What is the vision and goals of this project? What was the outcome?
  - Describe the technical architecture: from network to user platform.
  - In depth explanation of AMM design, use case constraints and calibration.
- **9 February: RWA Tokenization**
  - Introduce the tokenization of a Real World Asset of your choice. Explain technical, business design decisions.
  - Address one challenge relevant to the use case: Identity management through ZK technology or Data Stream/Feed Management through Chainlink
- **16 February: Gas Optimization Techniques**
  - Present an overview of existing gas optimization techniques and a brief explanation of each.
  - Code demonstration in Remix of two techniques, showing the gas reduction
  - **Bonus possibility: Optimization through assembly code**

In Class Presentations

- 15 min presentation + 3 min questions
- Every team member must speak during presentation
- These are not topics covered in class. They are an extension to the topics introduced in class as a test of your research competence.
- Check in the presentation repository for detailed guidelines
- Grading
  - 50% graded by professor
    - Check grading rubric on github
  - 50% voted on by your fellow classmates through a class DAO
    - It is your responsibility to make sure the vote is setup and there are votes. No votes means a zero for this part.
    - To avoid problems of collusion and manipulation encountered by small DAOs, professor reserves the right to veto the class vote