Part I:
- Please use the online 32-bit RISC V simulator:

https://www.kvakil.me/venus/
        or
https://www.cs.cornell.edu/courses/cs3410/2019sp/riscv/interpreter/

- Please write the RISC V code, run it online to test/debug, demonstrate it works, include your code in the PDF you upload – as text not as an image

- Your code is graded for (1) validity (it works) (2) size (fewer lines, higher grades) (3) discussion explaining choices you made and why

- You cannot use/copy parts of or all of anyone else's code

1. Write a RISC V program using instructions in the RISC V ISA to calculate the sum of the squares of all odd numbers between 0 and +N where N is an integer < 100

2. Write a RISC V program using instructions in the RISC V ISA to calculate the factorial of any positive integer N < 10

3. Write a RISC V program using instructions in the RISC V ISA to calculate the sum of all prime numbers less than a given integer N where N < 100

4. Write a RISC V program that calculates the sum of N terms in a geometric series where a = 1 and r = -3

Part II

1. Please read the ISSCC 2014 Keynote Publication by Professor Mark Horowitz *"Computing's Energy Problem (and what we can do about it)"* [1]

    1.1 How does Technology Scaling decrease the cost of Computing? How do reductions in the cost of manufacturing a transistor enable widespread use of computing devices?

1.2 Why did scaling processor clock frequency become more difficult in the last 15 years? How did Power dissipation become the primary constraint on server CPU performance?

1.3 Why is Moore's Law slowing down? Why did Dennard Scaling end?

1.4 Why is the energy consumption by Memory substantial ?

1.5 What solutions to Computing's Energy Problem does Professor Mark Horowitz's envision?

2. This assignment requires you to review several references on RISCV beginning with a summary transcript [2] of the Debate on Proprietary Vs Open Source Instruction Sets at the 4th Workshop on Computer Architecture Research Directions, June 2015 sponsored by the ACM.

This Debate between Professor David Patterson (author of the textbook you are using) and Dave Christie of AMD highlights all of the key technical and business arguments for and against an Open-Source ISA such as RISC V as of 2015 (the same year the RISC V Foundation was established). A Technical Report from EECS UC Berkeley highlights the technical reasons for Open ISAs [3] providing a more detailed discussion on the advantages offered by open source ISAs

(1) Articulate *your* views on the topics debated in [2]. Justify your views.

(2) Review and summarize technical reasons for Open-Source ISAs in [3].

References

[1] M Horowitz, *"Computing's Energy Problem (and what we can do about it)"* Plenary Session 1.1, 2014 ISSCC Digest of Tech. papers, Feb 2014 [*PDF attached*]

[2] M Hill et al, "Proprietary Versus Open Instruction Sets" 4th Workshop on Computer Architecture Research Directions, June 2015, ACM [*PDF attached*]

[3] K Asanovic et al, "Instruction Sets Should Be Free: The Case For RISC-V", EECS, University of California Berkeley, Technical Report No. UCB/EECS-2014-146, Aug 6 2014 [*PDF attached*]