Parallel Computing Notebook
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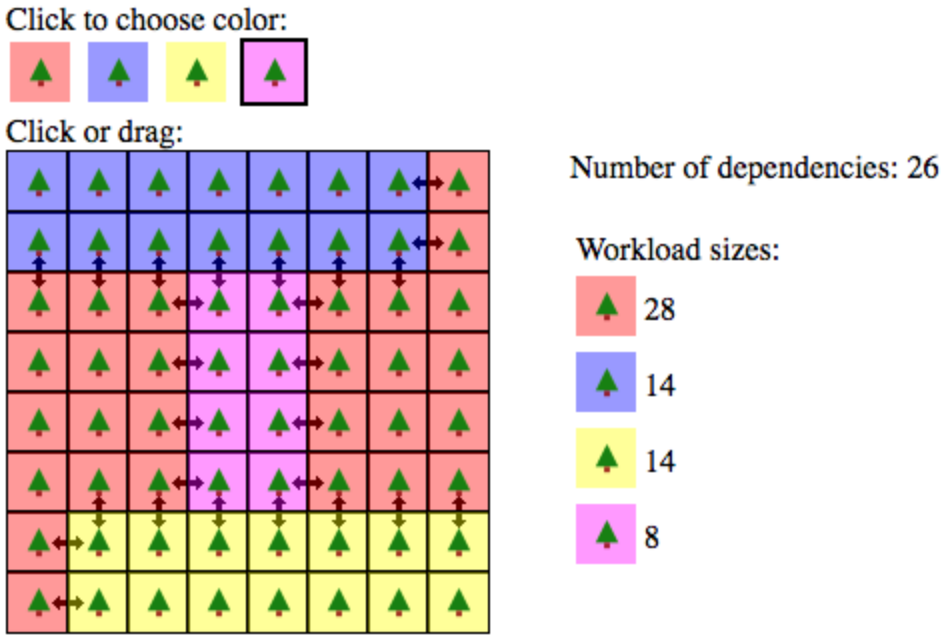
Flipping Coins in Parallel
Model Website

Q: If each worker can flip one coin per time step, how many time steps does it take the serial worker to flip two coins?
A:Two time steps
Q: How many time steps does it take two parallel workers to flip the two coins?
A: One time step
Q: Set the work size to 16. How many time steps does it take the serial worker to flip the coins?
A:Sixteen time steps
Q: How many time steps does it take the parallel workers to flip the coins?
A: Eight time steps
Q: Set the number of parallel workers to 4. How many time steps does it take the parallel workers to flip the coins now?
A: Four time steps
Q: Set the number of parallel workers to 8. How many time steps does it take the parallel workers to flip the coins now?
A: Two time steps
Q: From what you've seen, what is one reason why it would be a good idea to use parallel workers instead of a serial worker?
A: It takes less time to flip coins with parallel workers than with a serial worker
Q: Decrease the number of parallel workers to 2. Decrease the max time to 2. In 2 time steps, how many coins can be flipped by 2 parallel workers compared to one serial worker?
A: Four coins can be flipped by two parallel workers and two coins by the serial worker
Q: Increase the number of parallel workers to 4. In 2 time steps, how many coins can be flipped by 4 parallel workers compared to one serial worker?
A: Eight coins are flipped by the parallel workers
Q: Increase the number of parallel workers to 8. In 2 time steps, how many coins can be flipped by 8 parallel workers compared to one serial worker?
A: Sixteen coins compared to two coins
Q: From what you've seen, what is another reason why it would be a good idea to use parallel workers instead of a serial worker?
A: The parallel workers give more data
Q: Increase the max time to 16 time steps. Decrease the number of parallel workers to 2. Decrease the max worker memory to 2 coins. If each worker can only hold 2 coins in memory, what is the maximum number of coins that can be flipped by 2 parallel workers compared to 1 serial worker?
A: Four coins

Q: Increase the number of parallel workers to 8. If each worker can only hold 2 coins in memory, what is the maximum number of coins that can be flipped by 8 parallel workers compared to 1 serial worker?
A:sixteen coins
Q: From what you've seen, what is another reason why it would be a good idea to use parallel workers instead of a serial worker?
A: Parallel workers are able to do more work with less memory

Human Parallel Computer - Data Parallelism through Forest Fire Simulations
My number:3
Total number of students:18
My probability:0.167
Percentages:.34%,.69%,.69%,1.03%,.69%
Iteration counts:1,2,2,3,2
Average percentage:2.888%
Averge # of iterations:10
Q: What were some of the **tasks** we did in this exercise? What were they, and who did them?
A:we found averages
Q: What kinds of **data** did we work with in this exercise?
A:probability
Q: In which steps was there **communication** or **message passing** during this exercise (mark these steps)?
A:writing information
Q: In what ways could this exercise have been **optimized** so it could take less time?
A:we could have had more instructors
Q: How could we have run this exercise using two instructors instead of one?
A:The instructors could have split the work in half
Q: In what ways did we simulate a **parallel computer** in this exercise?
A: We all worked as a group
Domain Decomposition
Model Website

Image:



Q: If we assumed each color is assigned to a researcher in a real forest, and each researcher is studying how a fire spreads through the forest, why do we call them **dependencies**? Why do we call them **workload sizes**?
A: The workload sizes is the amount of work that each scientist has to do based on how much territory they have
Q: If we assumed each color is assigned to a computer running a simulation for that part of the forest, why do we call them **dependencies**? Why do we call them **workload sizes**?
A: Dependencies are how much time it takes to send a message
Q: Why would we want to minimize the dependencies?
A: so that the scientists or computers don't have to depend on others for information
Q: What are some reasons we might want to give more work to one of the colors/researchers/computers?
A: It minimizes dependencies

Parallel Recipes

My serial recipe-score a goal

Materials:

1. yourself
2. Soccer ball
3. Soccer net

Instructions:

1. Run from one side of the field while dribbling the ball
2. Get into a good position to kick the ball
3. Aim for the net
4. Kick the ball towards the net

Dependencies:

- yourself
- Soccer ball
- Soccer net

My parallel recipe
Materials:

1. yourself
2. Soccer ball
3. Your team
4. Soccer net

Instructions:

1. Run from your side of the field while dribbling the ball
2. Pass the ball to one of your team mates
3. Have them run while dribbling the ball
4. They get into a position to kick the ball
5. They kick the ball into the net

Q: In what ways was your **parallel** recipe different than your **serial** (non-parallel) recipe?
A:in a serial you only need one person, in a parallel you need more than one person.
Q: In what ways was your **parallel** recipe the same as your **serial** (non-parallel) recipe?
A:You need some of the same objects
Q: In what ways was your parallel recipe more efficient? In what ways was it less efficient?
A: You are able to make the goal faster
Q: Did anything need to change about the resources/materials/ingredients/tools in your recipe when you went from serial to parallel?
A: adding another person
Q: In what ways do you think this activity relates to computing and parallel computing?
A:in parallel computing there are many calculations happening at the same time

<u>Going Shopping</u>
Solutions:

1. One person goes for everything
2. Twelve go at a time
3. Call the parents

What if's:

1. Supermarket is closed
2. Van doesn't work
3. Not enough space in van
4. Not enough money
5. Inability to drive
6. allergies

Q: Where is there inherent **parallelism** in your solutions?
A: If twelve go at a time then there are more people doing the same thing
Q: Where are there **dependencies** between tasks in your solution?
A: If one person goes then you are depending on that person.
Q: Where is there **communication** in your solution?
A: Communicating between you and the children's parents

Parallelism in Nature

1. Model link:http://www.shodor.org/interactivate/activities/ABetterFire/Data:
   Tasks:how many trees are left
   Parallelizable data:speed of trees getting burned
   Parallelizable tasks:trees getting burned

Q: What patterns do you notice in the types of data and tasks that can be parallel?
A:how many trees are getting burned and how many trees are left
Q: What patterns do you notice in the types of data and tasks that cannot be parallel?
A: the speed of the fire spreading

Careers in High Performance Computing

Career:Mechanical Engineering
How HPC can be used in that career:
Sources:http://www.engineering.com/Hardware/ArticleID/12764/What-Is-High-Performance-Computing-and-How-Can-Engineers-Use-It.aspx

- Can be used to design airplanes

The World's "Fastest" Supercomputers

Q: When was the most recent Top500 list published?
A: November 2016
Q: What is the name of the fastest supercomputer in the world according to the most recent list?
A: Sunway TaihuLight
Q: Where is that supercomputer located?
A: China
Q: How many **cores** does it have?
A: 10,649,600
Q: How much **peak performance (RPEAK)** does it have?
A: 125,435.9TFLOP/S
Q: How many of the Top500 sites in the top 10 are located in the United States?
A: 3
Q: If the **Blue Waters** supercomputer was capable of a **peak performance** of **13,000 TFLOP/S** when it came on-line in 2012, where would it be listed in the November 2012 list?
A: 3rd
Q: Why doesn't Blue Waters appear on that list?
A: they opted out of the list

Source:
Q: What are **cores**?
A: the central processing unit that does the computing
Q: What does **TFLOP/S** stand for?
A: trillion floating point operation per second
Q: What does **Linpack** measure?
A: how fast they can do mathematical equations
Q: What would be some different ways to rank supercomputers?
A: they can be tested by using different applications.

LittleFe
Where the name comes from:Big Iron is a slang for big supercomputer, little fe is for small supercomputers
Components:

- motherboard(x6)
- CPU
- Core(2 per CPU)
- Hard Drivers(x1)
- Network(ethernet)
- Ram(memory)(1-4GBmotherboard)
- Powersupply
- cooling(fan, heat sink)
- case

Blue Waters demo
YouTube video

Q: What are the advantages to using a remote supercomputer as compared to a local supercomputer like LittleFe?
A:They can send back visualizations
Q: What are the disadvantages?
A: They take up more space

Parallel Computing: Terminology and Examples
Slides

Shopping for Your Own Supercomputer

- Part:
  Cost:
  Link:

Q: What are the most important parts of a supercomputer?
A: Motherboard,CPU,Ram,Cooling system

Q: What assumptions did you make when you did your shopping? Which of these assumptions were false?
A: what kind of component you need

Daqri demo
Q: What are some of the ways you can envision augmented reality being used for science?
A:
Q: What specific scientific examples can you think of that would benefit from augmented reality?
A: