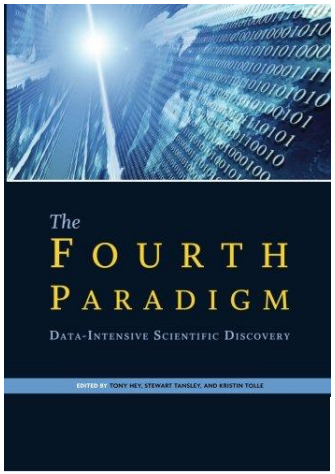
Using Work Queue Inside and Outside the Classroom

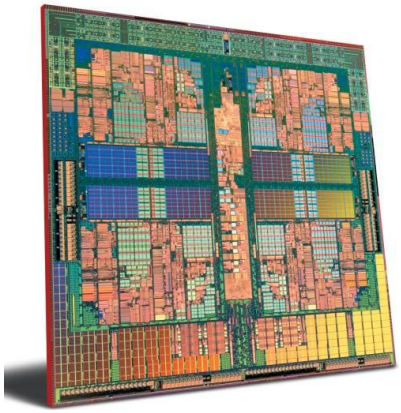
Peter Bui

University of Wisconsin - Eau Claire

Motivation

Problem: Introducing PDC





NVIDIA CUDA

amazon web services™

XSEDE
Extreme Science and Engineering Discovery Environment

Parallel and **distributed computing** are becoming increasingly **important**.

Solution: Work Queue

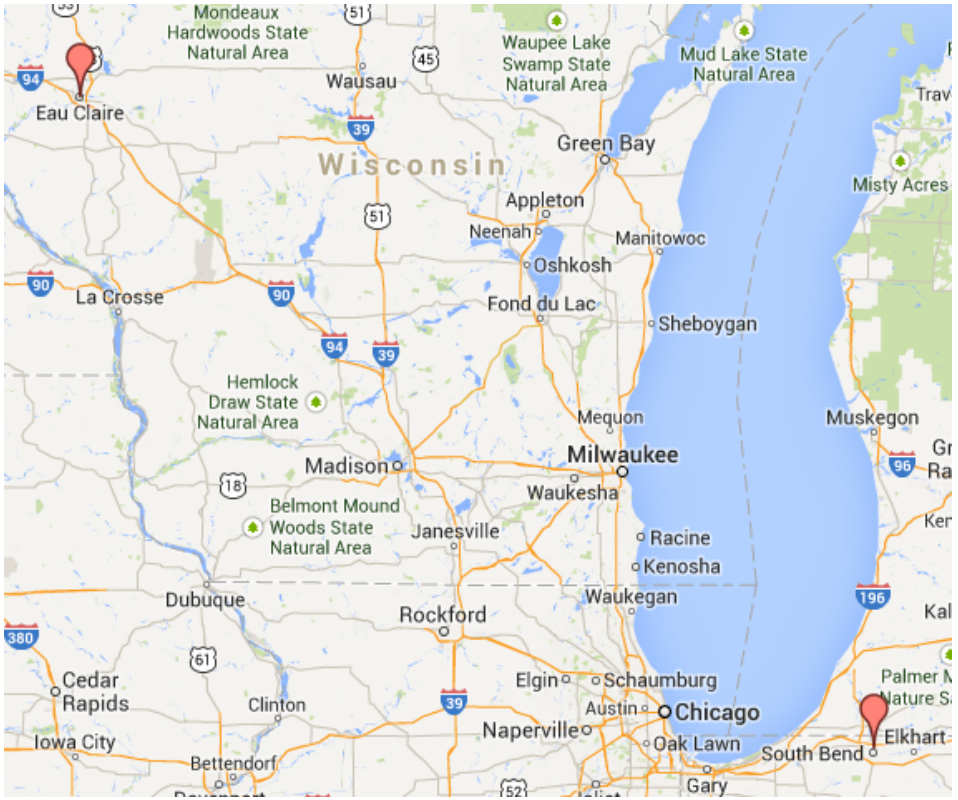
Use **Work Queue** to introduce undergraduates to **parallel** and **distributed computing** in the context of:

- **Class Assignments**
- **Independent Study**
- **Undergraduate Research**

Background

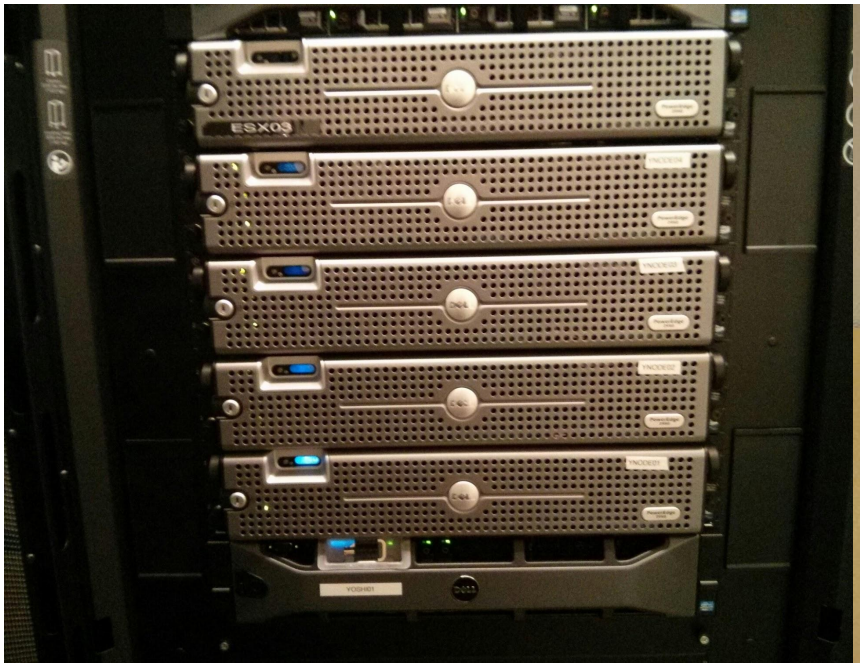
Teaching and Research @ UWEC

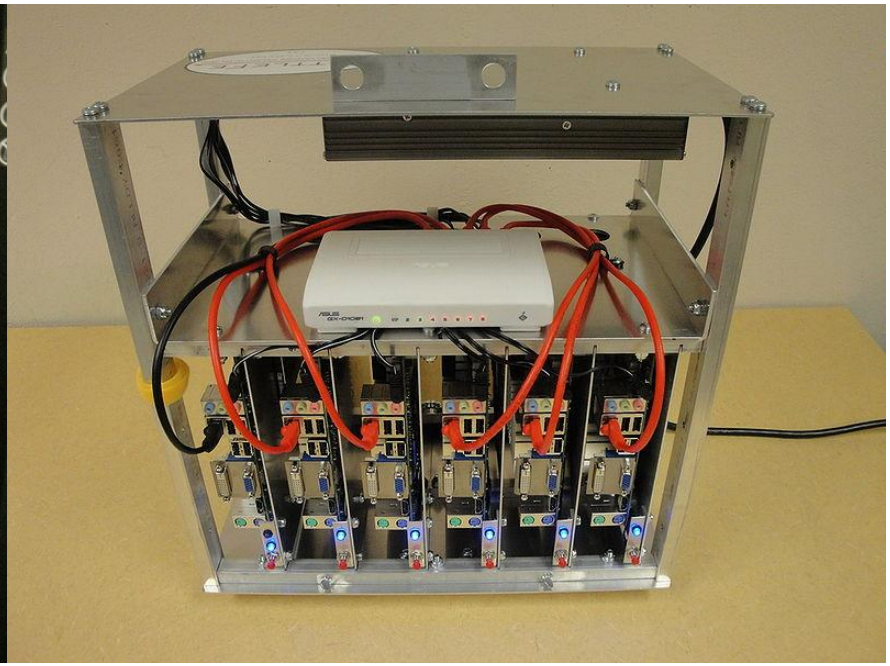
Liberal arts, **undergraduate** focused university.



Emphasize **teaching** and faculty/student collaborative **research**.

Distributed Computing @ UWEC





CENTER FOR
HIGH THROUGHPUT
COMPUTING

Teaching

Teaching Approach

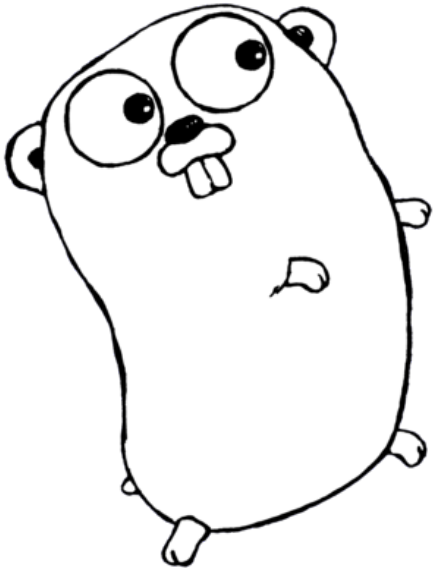
- **Core**
  - Computer Organization and Design
- **Service**
  - Introduction to Programming in C++
  - Computing for the Sciences and Mathematics
- **Elective**
  - Cloud Computing
  - Unix Systems Programming

Work Queue MapReduce

```
WorkQueue MapReduce
================================================================================

             Name: wqmr-buipj
             Port: 9001
   Work Directory: ./wqmr-buipj

              Map: [==================================================] 100.00%
           Reduce: [==================================================] 100.00%

          Workers: I:        0 R:       12 B:        0 J:       12 Q:        0
            Tasks: W:        0 R:        0 U:        0 D:      981 C:      981
             Data: S: 237.21MB R: 706.65KB

       Start Time: Fri Oct 11 12:40:57 2013
        Work Time: Fri Oct 11 12:41:09 2013
     Elapsed Time: 58
Elapsed Work Time: 45

       Last Event: Task r0000 returned with exit status 0
```

Brute-force Password Cracking

Using **Go**, students implemented a brute-force password cracker:



- **Serial** version
- **Parallel** version using **CSP**
- **Distributed** version using **Work Queue**

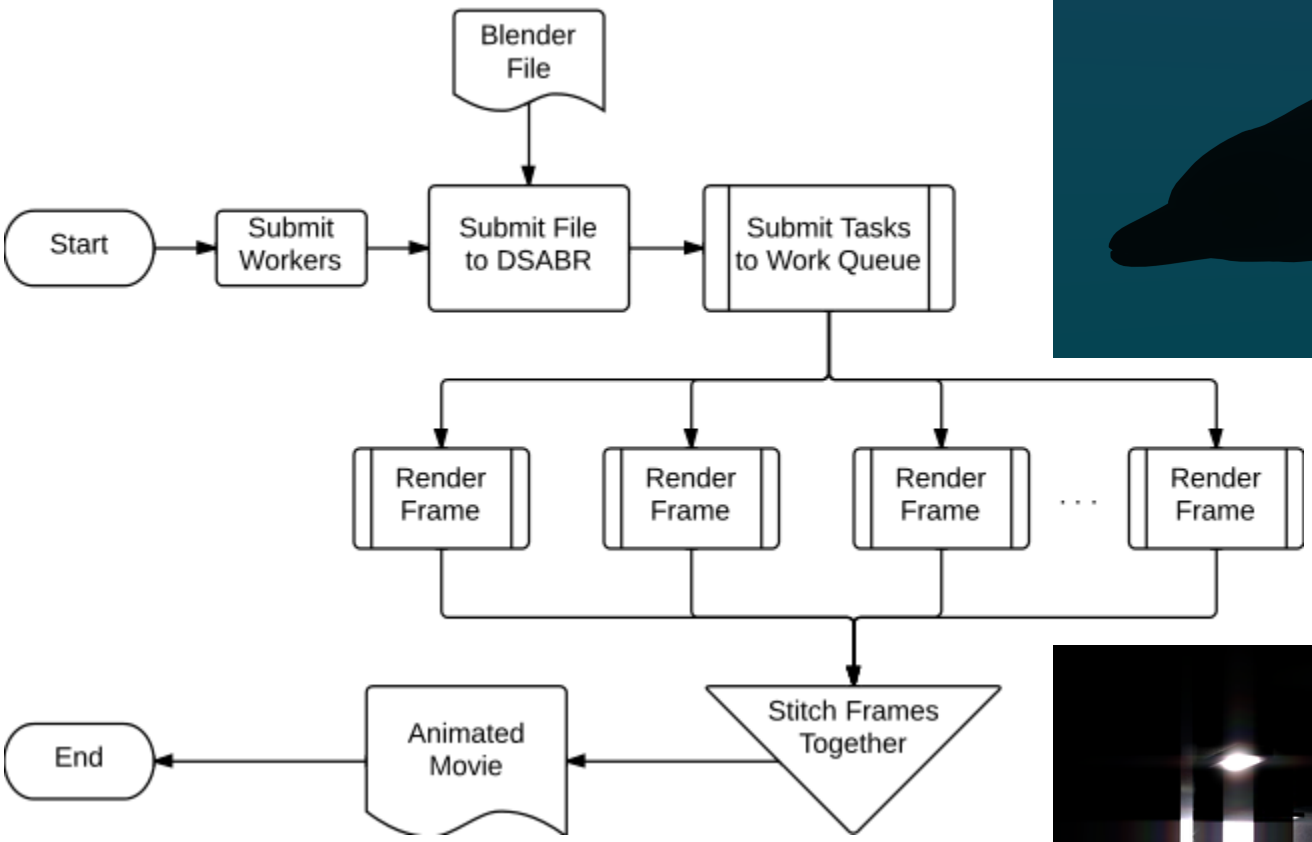
Research

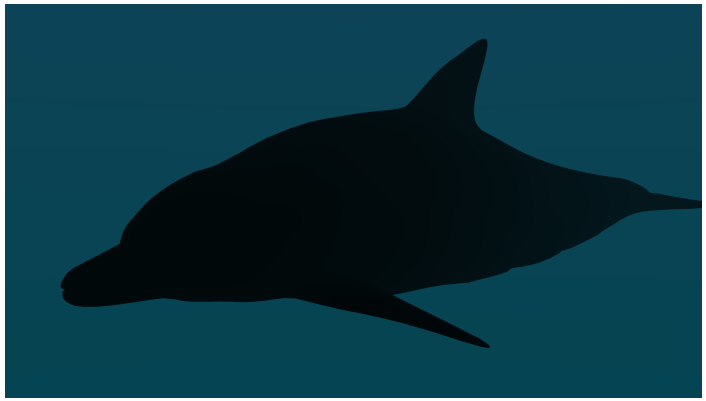
Research Approach

- Focus on high-level **applications**
- Take advantage of **frameworks**
- Keep students **engaged** and **motivated**
- Reach out and take advantage of **resources**

Work Queue *is a great framework for enabling novice users to explore* ***parallel*** *and* ***distributed computing****.*

Distributed Animation Rendering





Distributed Animation Rendering

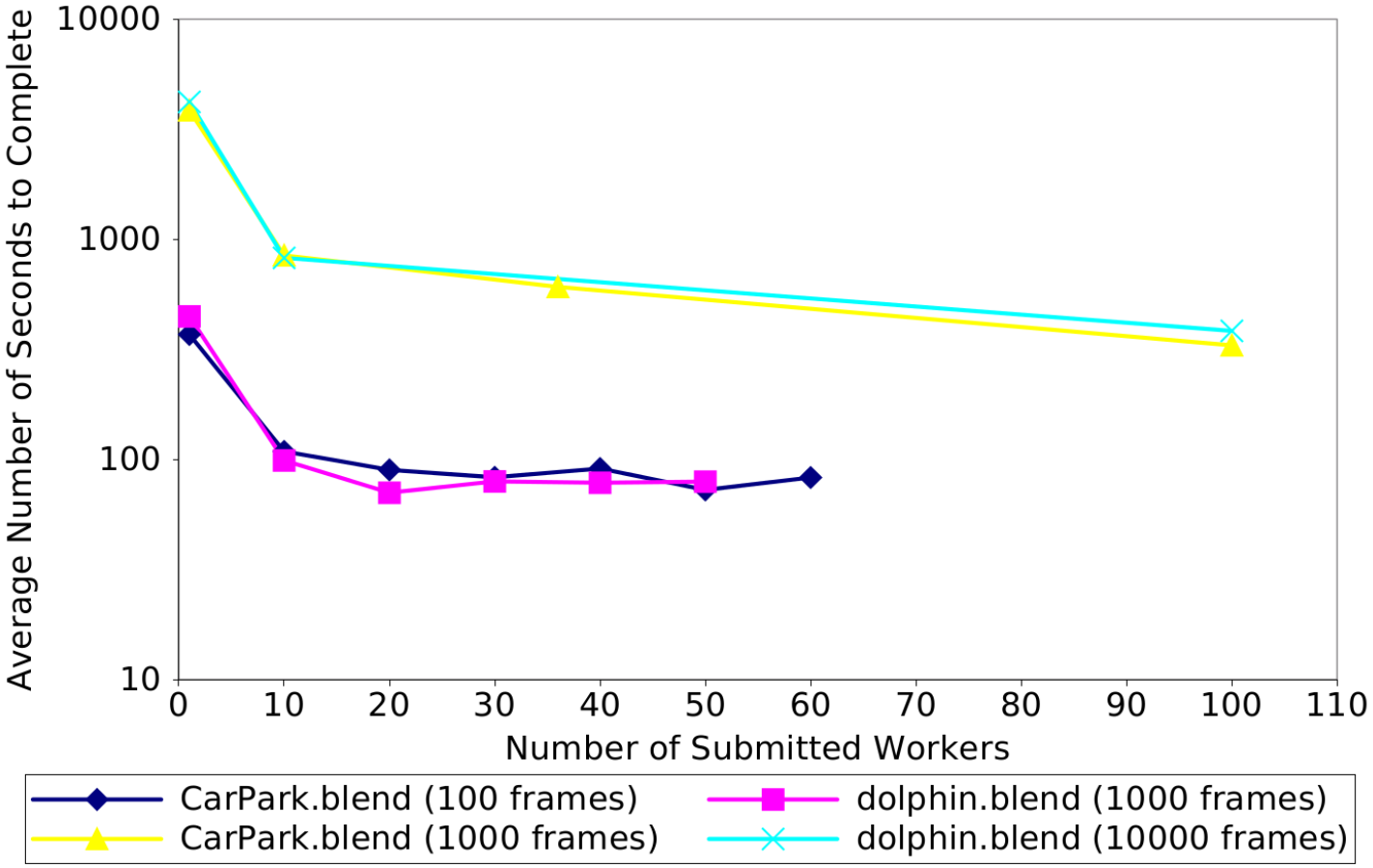


Photo Processing Pipeline

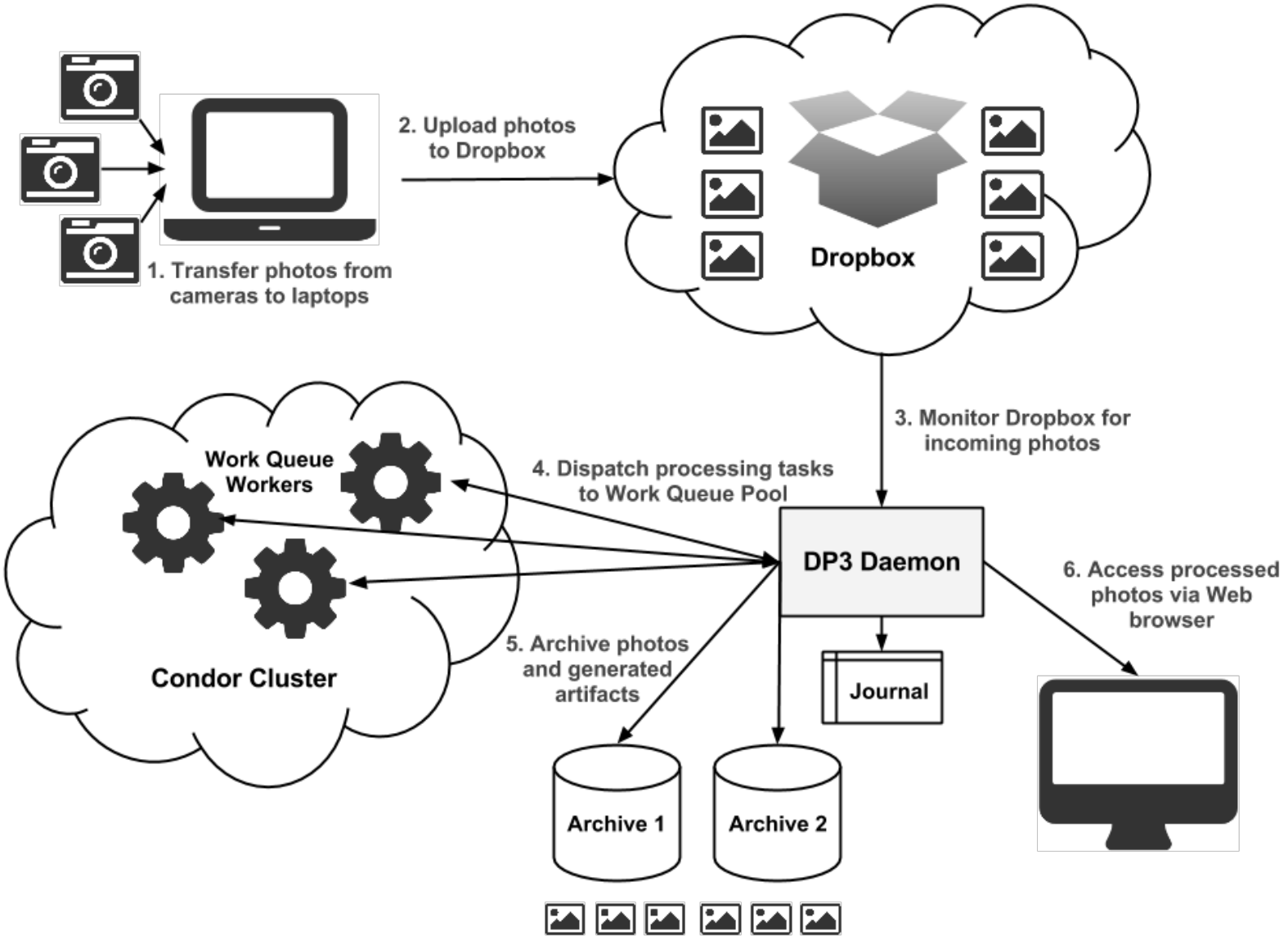
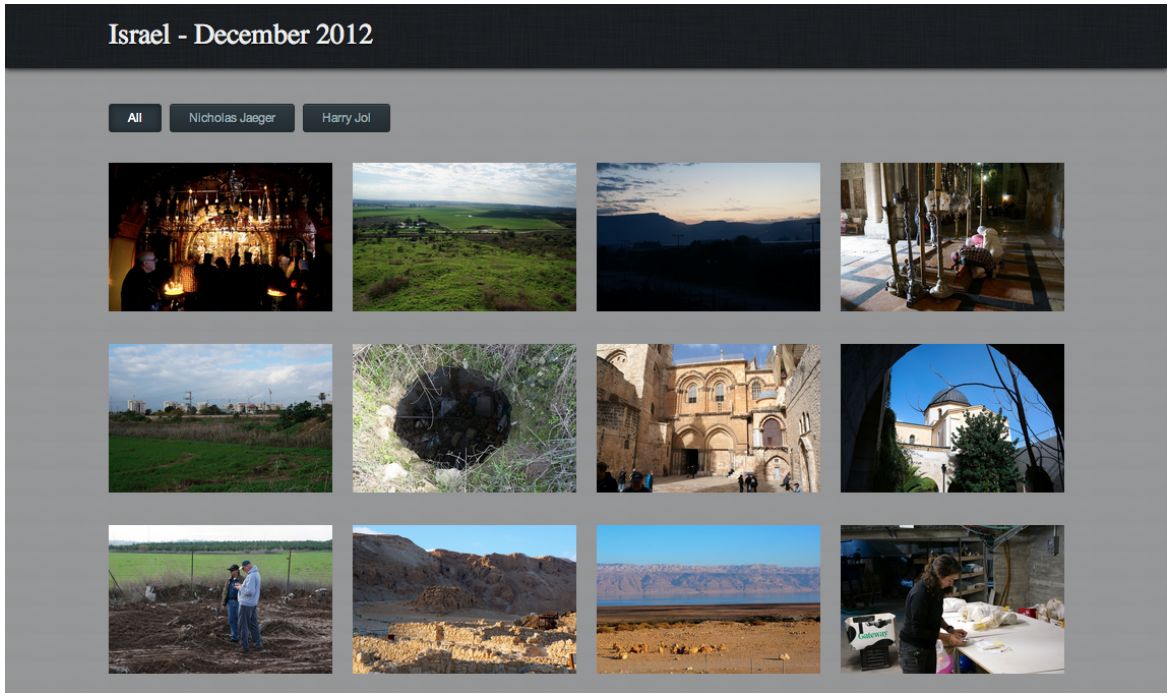
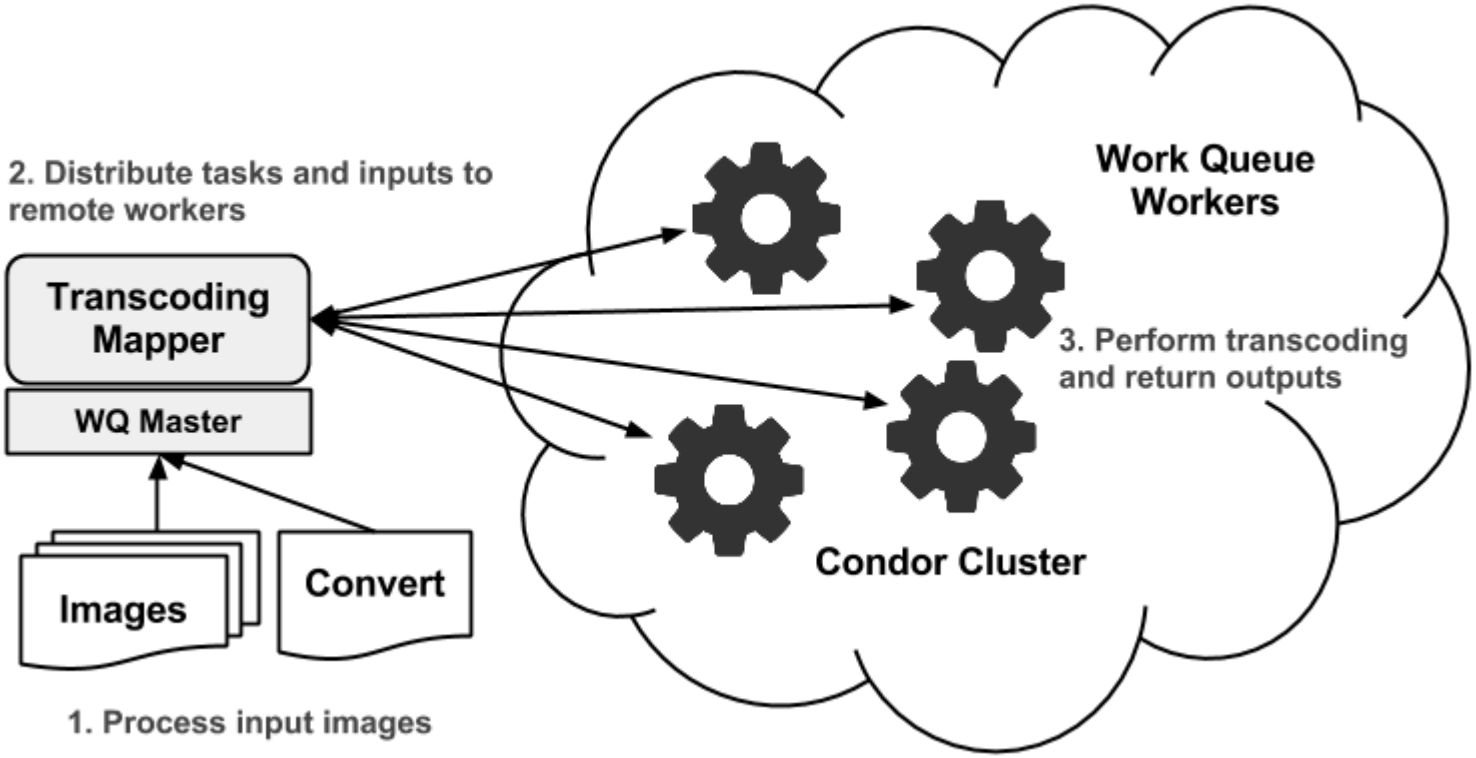


Photo Processing Pipeline



Num of Batches	448	**Num of Tasks Submitted**	7372
Max Batch Size	1385	**Num of Tasks Failed**	104
Min Batch Size	1		
Avg Batch Size	16.4		

Scalable Image Transcoding

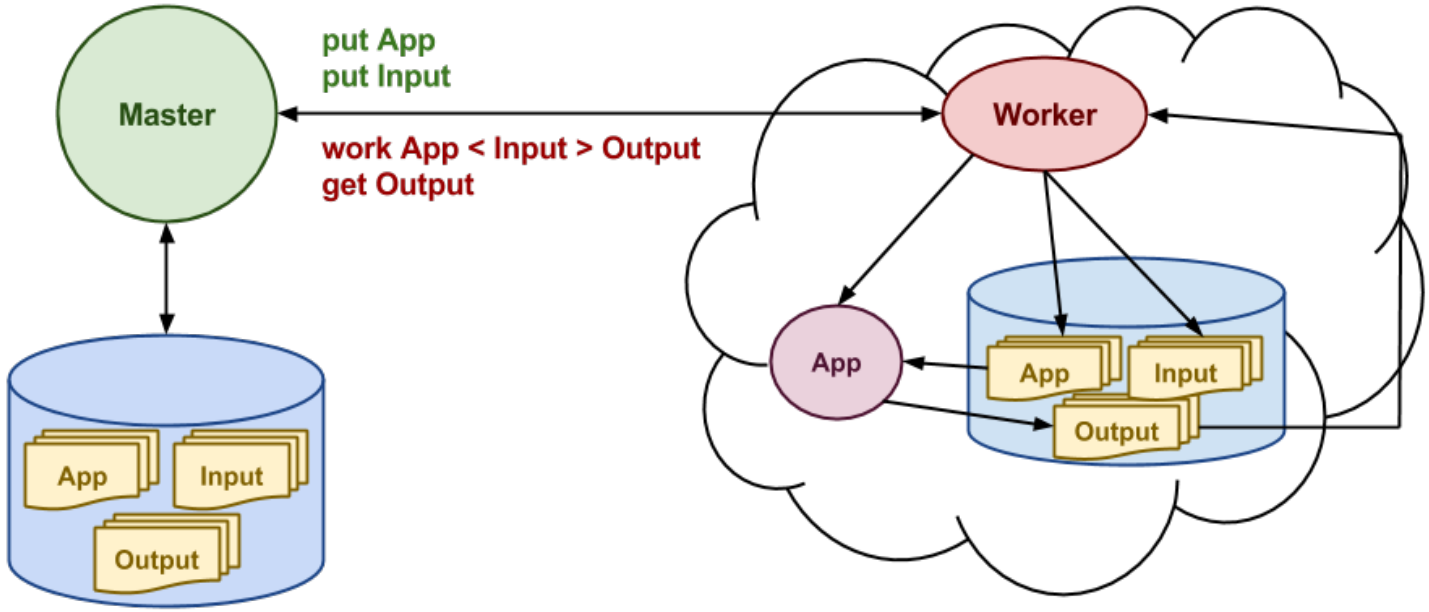


Scalable Image Transcoding

File Size	Set Size	# of Workers						
		1	2	4	8	16	24	30
15KB	10	1x	1.47x	1.56x	2.13x	1.85x	2.00x	**2.40x**
	100	1x	1.60x	2.80x	4.43x	5.96x	6.42x	**6.44x**
	1000	1x	1.65x	3.12x	5.02x	7.97x	9.27x	**9.31x**
1MB	10	1x	1.65x	2.40x	2.78x	3.05x	3.73x	**3.87x**
	100	1x	2.10x	3.87x	6.55x	**9.56x**	7.65x	8.27x
	1000	1x	2.17x	4.28x	7.75x	11.2x	10.5x	**12.12x**
10MB	10	1x	1.84x	2.46x	2.88x	**4.48x**	3.43x	3.27x
	100	1x	1.98x	3.90x	4.95x	**7.34x**	4.61x	4.76x
	1000	1x	1.74x	3.97x	5.63x	**6.26x**	4.75x	4.93x

Final Thoughts

Summary



- **Work Queue** is **easy to use**.
- **Work Queue** is **flexible**.
- **Work Queue** is **portable**.
- **Work Queue** is **extensible**.

Work Queue is a great way to introduce **PDC** to undergraduate students!

Future Work

Teaching

- Incorporate into **Computational Science** course
- Introduce in Computer Science **systems** course

Research

- **Web portal** for art students to utilize **DSABR**
- **Visualization** and **monitoring** of **Work Queue**

Acknowledgements

- **Students**

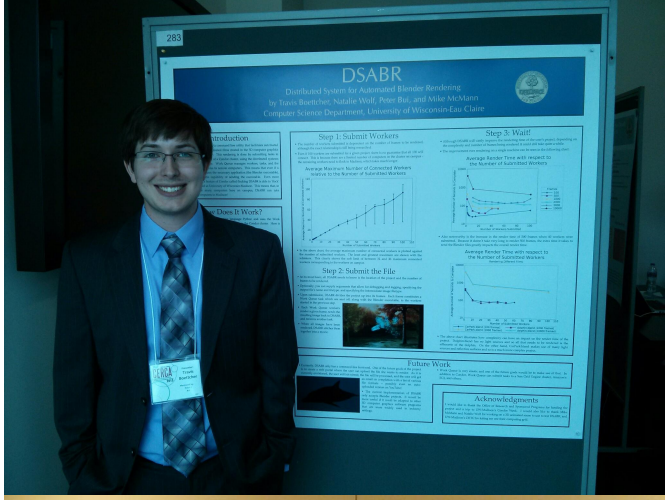
  Travis Boettcher, Nick Jaeger, Jeffrey Westphal

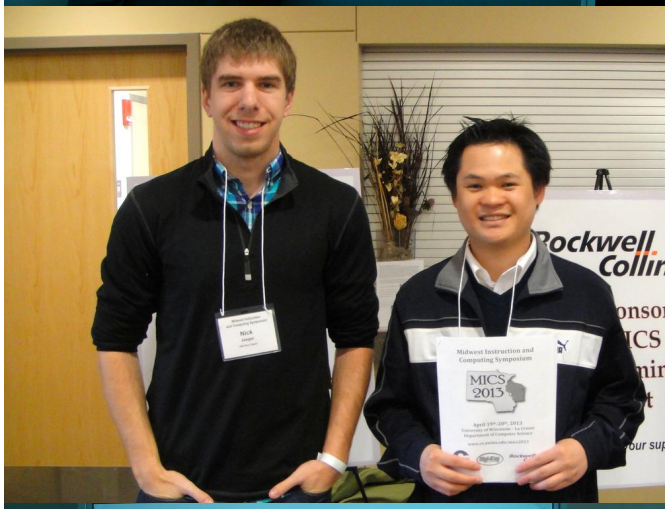
- **ORSP**

  Travel funding and student stipends

- **CHTC**

  HTCondor flocking





Questions?

Peter Bui

EMail: buipj@uwec.edu

WWW: http://cs.uwec.edu/~buipj