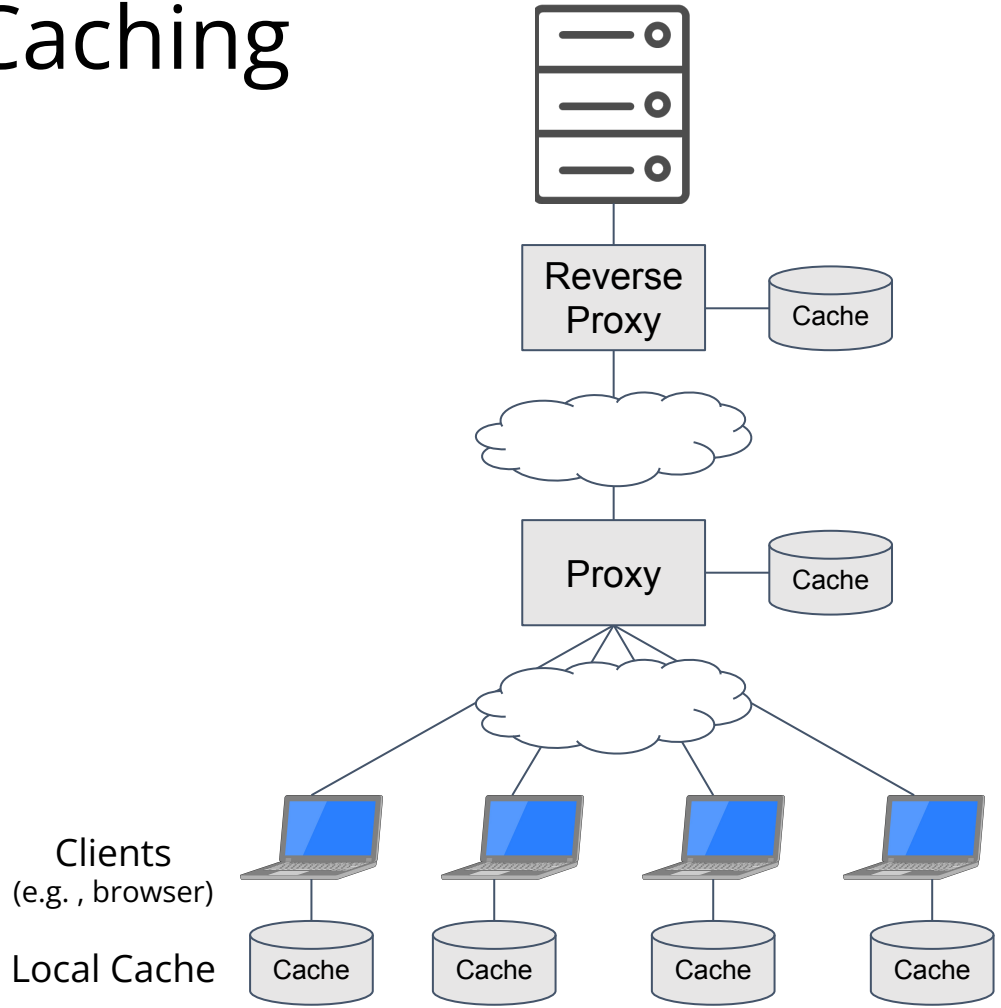
COS 316
Precept:
Cache Eviction
(Replacement)

Overview of Web Caching

- Basic idea:
  - Bring objects “closer” to clients
- Three primary features:
  - Reduce network bandwidth
  - Reduce client-perceived delays
  - Reduce load on server
- Cache Replacement Strategy
  - When a cache becomes full, which object should be **evicted/replaced**?



Cache Eviction Algorithms

- High level
  - Client requests a new object
  - If object is in cache, return the object
  - If object is not in cache:
    - Get object from server/provider and return the object
    - Cache full:
      - Identify an object in cache to evict
      - Evict the object in the cache
      - Replace with new object
    - Cache not full:
      - Admit the new object to the cache

Cache Eviction Algorithms

- Least recently used (LRU): Evict the object from the cache whose last request is the oldest
- First-in, First-out (FIFO): Evict the object from the cache that has been in the cache the longest
- Many others…

LRU

id:	8
size:	10
request:	__:__
admit:	__:__

Current time: 16:00

id:	8
size:	10
request:	__:__
admit:	__:__

Current time: 16:00

id:	6
size:	2
request:	13:00
admit:	11:00

id:	3
size:	10
request:	13:45
admit:	13:45

id:	1
size:	3
request:	15:01
admit:	12:01

id:	4
size:	5
request:	11:53
admit:	11:33

id:	11
size:	8
request:	11:30
admit:	11:30

id:	7
size:	17
request:	13:30
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Cache capacity = 50
Cache size = 45

id:	6
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Experiments

```
> cd <Precepts repo>
> git pull # update with precept5 code and data
> cd precept5/webcachesim-master
> make
```

Trace File Form

- Request traces must be given in a space-separated format with three columns
- time - long long int
- id - long long int, used to uniquely identify objects
- size should be a long long int, object's size in bytes

- Example

```
time    id  size
1       1   120
2       2   64
3       1   120
4       3   14
4       1   120
```

- See `test.tr`

Using the Simulator*

```
> ./webcachesim test.tr LRU 1000

LRU:1000 bytes, 10492 reqs, 8495 hits, 81 hits/reqs(%)

> ./webcachesim test.tr FIFO 1000

FIFO:1000 bytes, 10492 reqs, 8206 hits, 78 hits/reqs(%)
```

* Derived from https://github.com/dasebe/webcachesim

Experiments

- Trace data from a production CDN
  - cd1-10M.tr *
  - 10 million requests / Object sizes from 10 byte to .7GB
- LIFO and FIFO
- Vary cache sizes
  - 16000000
  - 32000000
  - 64000000
  - 128000000
  - 256000000
  - 512000000
  - 1024000000
  - 2048000000
  - 4096000000

- Create a Google Sheet
- Three columns
- SIZE LRU FIFO
- Copy results accordingly
- Select three columns to create line chart

* Practical Bounds on Optimal Caching with Variable Object Sizes Daniel S. Berger, Nathan Beckmann, Mor Harchol-Balter. ACM SIGMETRICS, June 2018

Experiments

- LRU and FIFO
- Vary cache sizes
  - 80
  - 160
  - 320
  - 640
  - 1280
  - 2560
  - 5120

- Create a Google Sheet
- Three columns
- SIZE LRU FIFO
- Copy results accordingly
- Select three columns to create line chart