NS2 Network and System Security Laboratory KAIST

Assignment #1

Implementing a network service that can handle large scale network requests

** Co-worked with Jaehyun Nam*

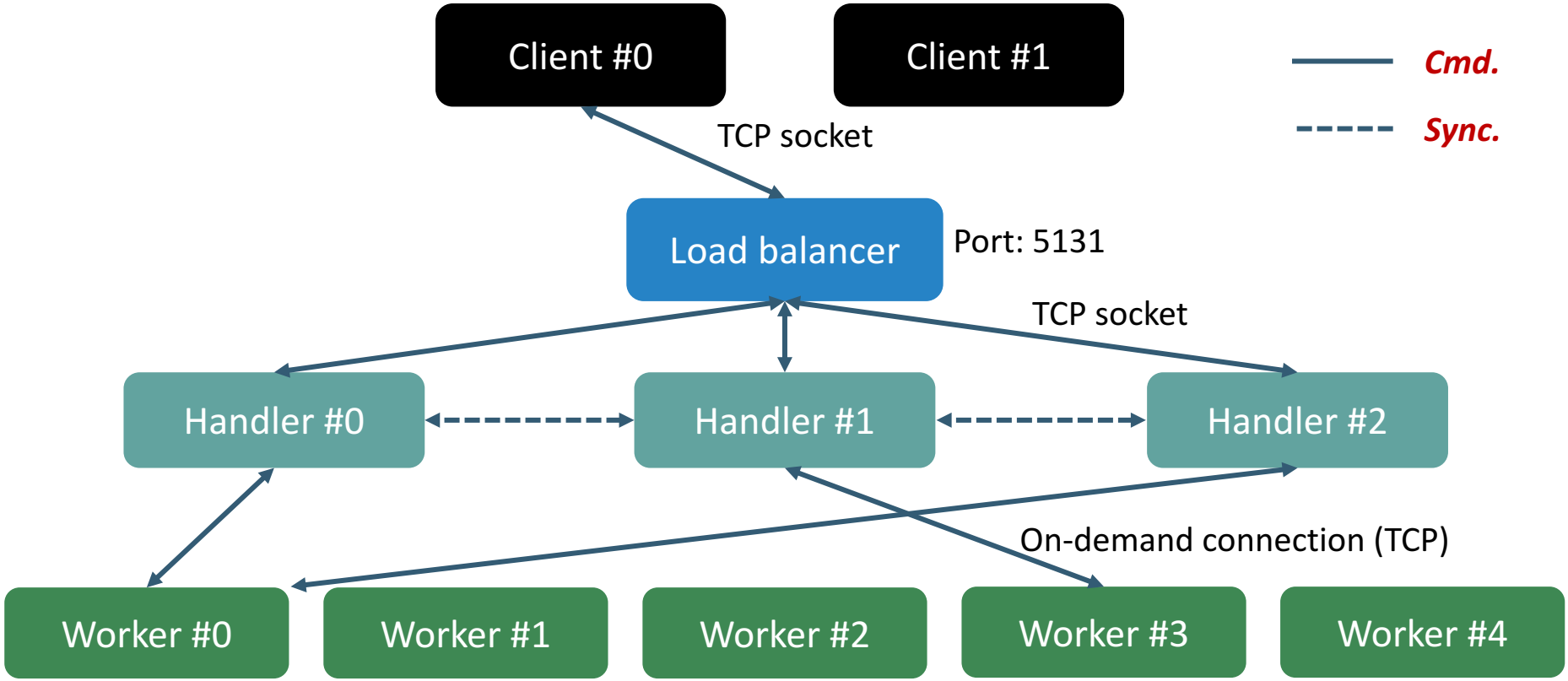
High-level functions

- ***Ultimate Goal: Build a distributed key-value storage system***

- Store/retrieve data as a ***key-value pair***
- Handle ***bulk requests*** with I/O multiplexing and load balancing
- Write ***logs*** and provide ***CLIs*** to interact with users

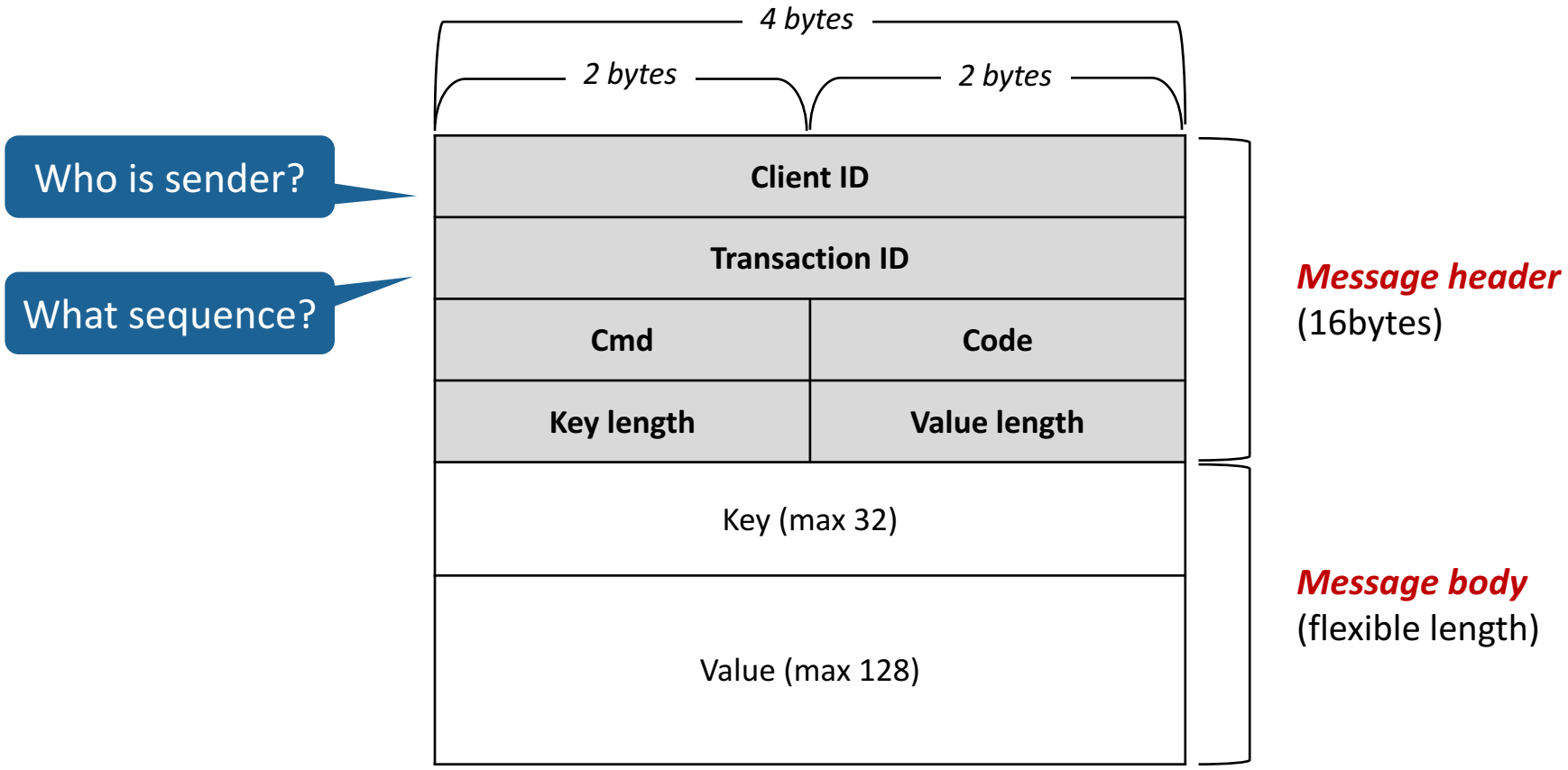
Overall architecture

- All components = processes



Protocol

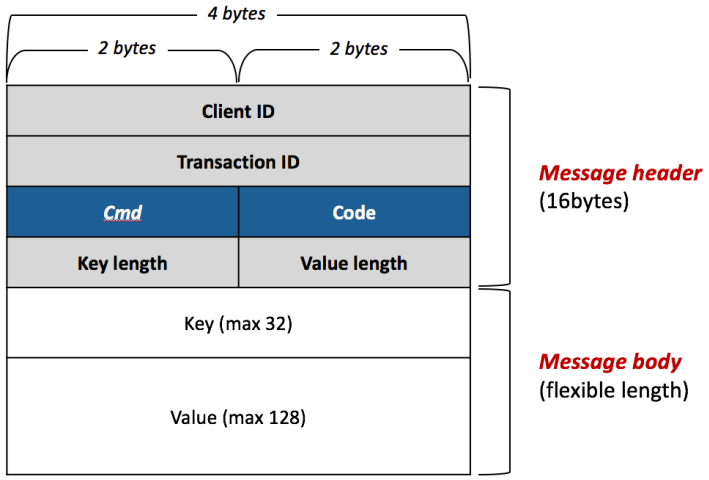
- Data format



Protocol(Cont'd)

- Cmd
  - Identify ***commands***
  - ***put***: 1, *put-ack:* 2, ***get****:* 3, *get-ack:* 4, ***del****:* 5, *del-ack:* 6
- Code
  - Represent ***status*** for *put-ack, get-ack,* and *del-ack*
  - ***none****:* 0, *success:* 1, *not exist:* 2, *already exist:* 3

** Only used for non-ack messages*



Examples

- Client #1 requests ***"put"*** a *{hello, helloworld}* pair into the system ***(sequence #24)***

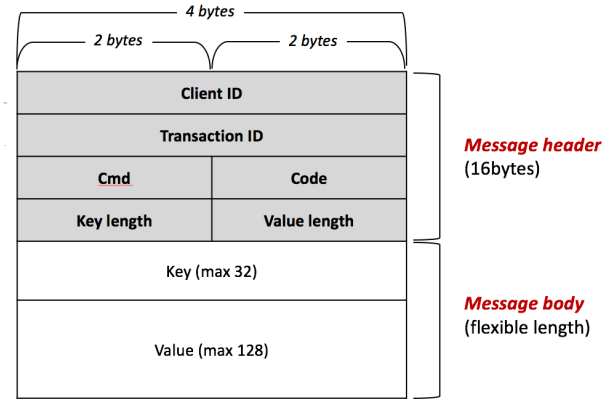
1	24	1	0	5	10	hello	helloworld

put *none*

- The ***"put"*** *message* requested by Client #1 was successfully stored on the system***(sequence #24)***

1	24	2	1	0	0		

success



Examples(Cont'd)

- Client #2 requests ***"get"*** a *{hello}* key to the system ***(sequence #25)***

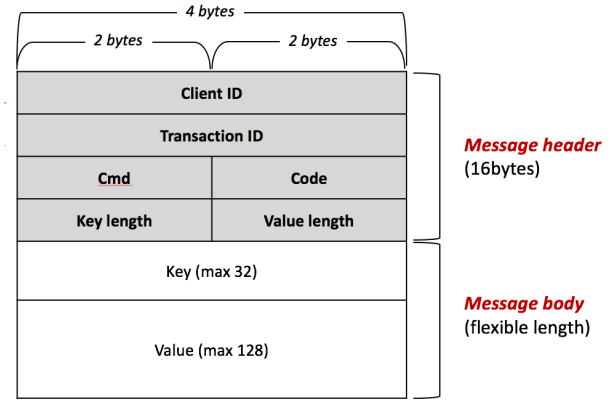
1	25	3	0	5	0	hello	

get *none*

- The ***"get"*** *message* requested by Client #2 was successfully found on the system***(sequence #25)***

1	25	4	1	5	10	hello	helloworld

success

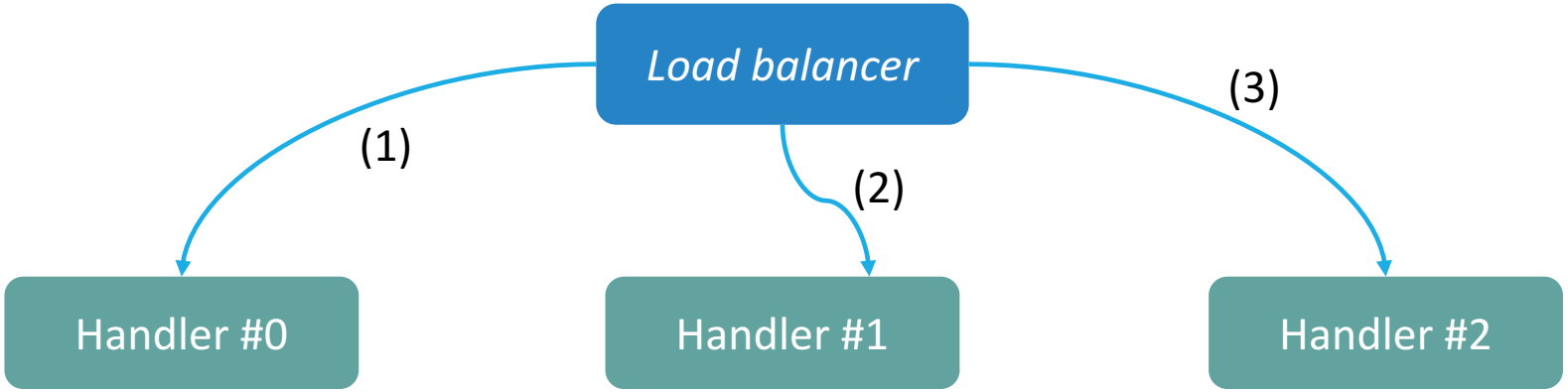


Operations – Load balancer

- Request delivery to ***a specific handler*** according to a LB strategy

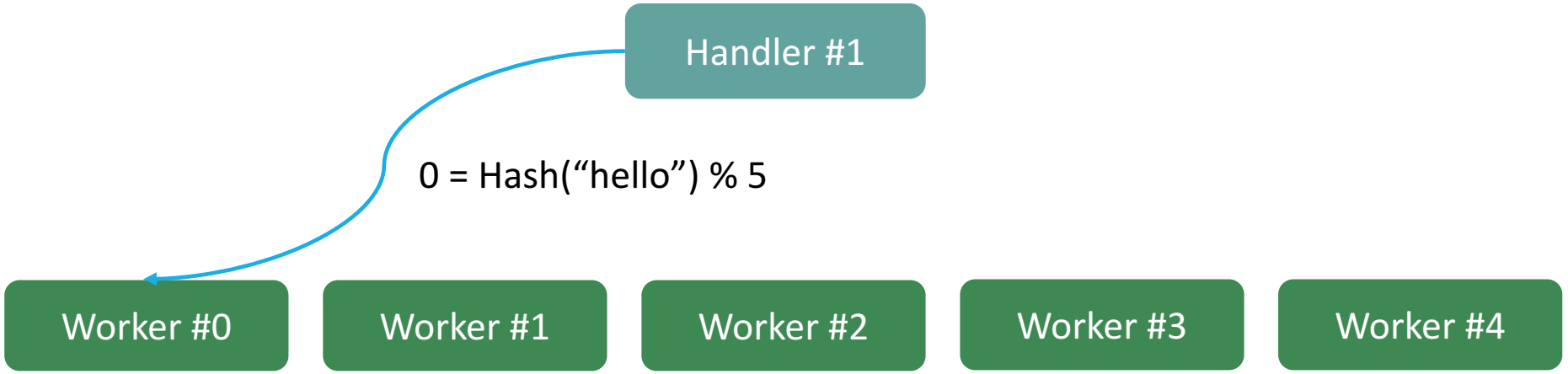
  ➔ ***Round-robin***

- Response delivery to the corresponding client



Operations - Handler

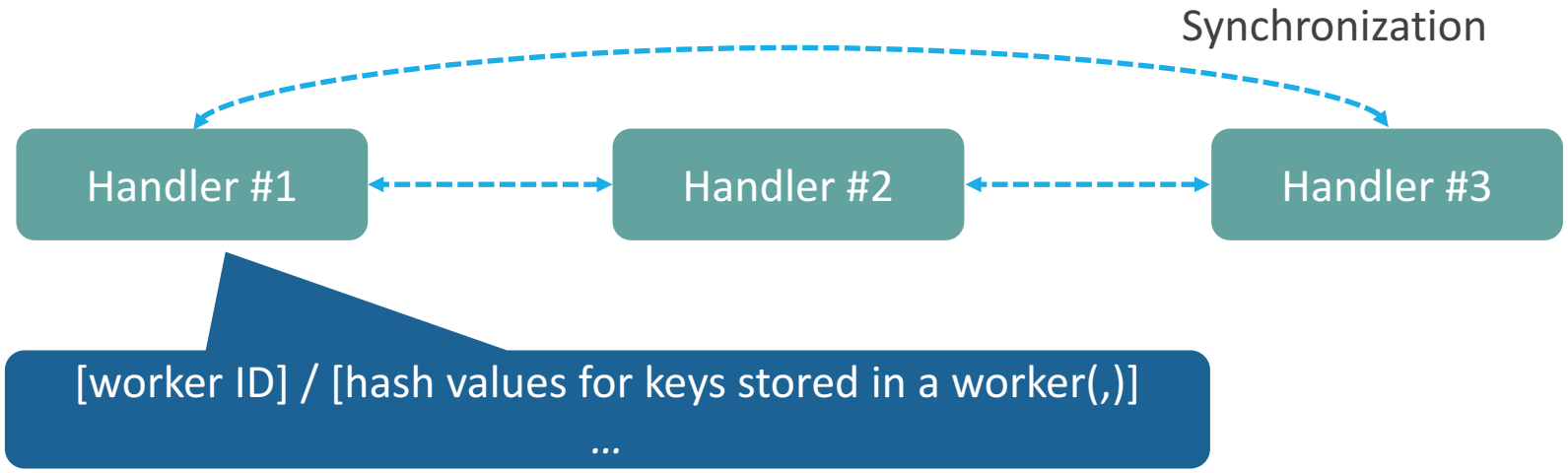
- Request delivery to a specific worker and response delivery to the load balancer
  - ***Target worker = Hash(key) % # of workers***
  - You should use ***Jenkins hash function(one-at-a-time)***
    - See https://en.wikipedia.org/wiki/Jenkins_hash_function



Operations – Handler(Cont'd)

- Management of ***key-value distributions***
- ***Synchronization*** of key-value distributions among handlers
  - All handlers should eventually know all key-value distributions

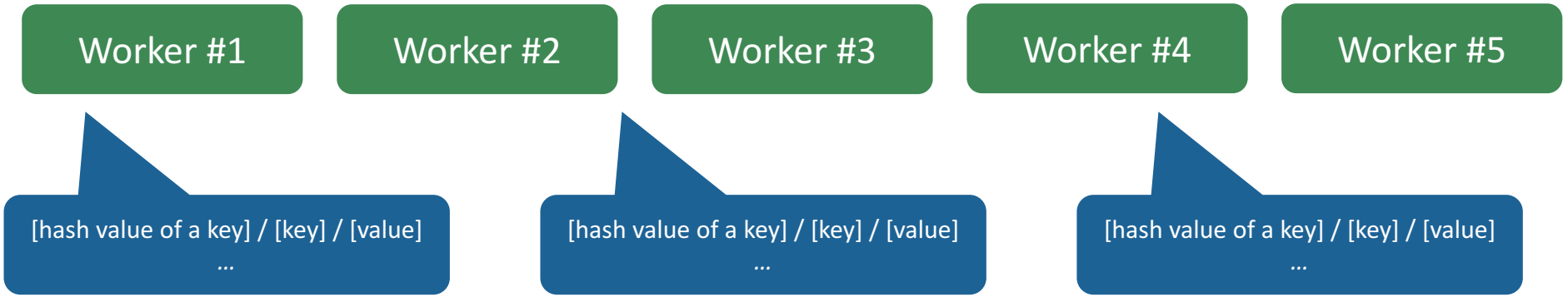
** ignore the strong consistency and failure issues*



Operations - Worker

- ***Put*** a pair of a key and a value into its data table
- ***Get/Del*** a value of a key from its data table

** ignore the failure issue*



Requirement #1 - Message logging

- All received messages ***should be written*** in log files
- Format: *[component_name].log* (e.g., handler_2.log, worker_1.log)
- Contents:
  - *[time] [client id] [transaction id] [cmd] [code] [key length] [value length] [key] [value]*
  - *[time] [client id] [transaction id] [cmd] [code]*

Requirement #2 - CLI

- Client's CLI(Example)

```
Client> connect [LB IP]

Client> set 1
Client #1>
```

```
Client #1> put [key] [value]
Success
  or
Fail (reason: already exist)
```

```
Client #1> get [key]
[value]
  or
Fail (reason: not exist)
```

```
Client #1> del [key]
Success
  or
Fail (reason: not exist)
```

Requirement #2 – CLI(Cont'd)

- Load-balancer's CLI

```
LB> list
[handler ID] / [handler IP address / port] / [# of requests]
```

- Handler's CLI

```
HD# [handler ID]> list
[worker ID] / [hash values for keys stored in a worker(,)]
HD# [handler ID]> show [worker ID]
[hash values for keys stored in the worker]
```

- Worker's CLI

```
WK# [worker ID]> list
[hash value of a key] / [key] / [value]
WK# [worker ID]> show [key]
[hash value of the key] / [key] / [value]
```

Notice

- Languages
  - C / Java
  - ***Please DO write comments in your code (be concise)***
- Tests
  - Your system MUST be implemented as ***separate modules***(Clients, Load Balancer, Handlers, Workers)
  - TAs will conduct ***module tests*** to evaluate your system
  - TAs will validate your system ***with other students' clients***
- Environments
  - Ubuntu 14.04.5 LTS (Trusty Tahr) 64-bit

Notice(Cont'd)

- We ***highly*** recommend that you use ***vagrant***
  - Install VirtualBox: https://www.virtualbox.org/
  - Install Vagrant: https://www.vagrantup.com/downloads.html
  - Type the following commands
    - $ mkdir PATH_TO_BOX; cd PATH_TO_BOX
    - $ vagrant init ubuntu/trusty64
    - $ vagrant up
    - $ vagrant ssh

    } You just need to use this after installation

  ** Borrowed by Sang Kil Cha's slide*

Grade

- Total ***200pts***
  - **40pts** Documentation (Including README)
  - **20pts** Request and response in a client
  - **20pts** Load-balance requests to handlers in a load balancer
  - **20pts** Maintain key-value distributions in a handler
  - **20pts** Synchronize the distributions among handlers
  - **20pts** Manage a key-value table in a worker

Grade(Cont'd)

- **60pts *handle burst requests***
  - 10,000 (10pts) ~ 100,000 (60pts) requests per second
  - 100,000 ***random unique*** key-value requests
    - ***Put*** 50,000 pairs
    - ***Get*** 25,000 pairs (1/2 pairs exist), and ***Del*** 25,000 pairs (1/2 pairs exist)