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# Week5 Project 1

## COMP90007 Internet Technology

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# Overview of the project

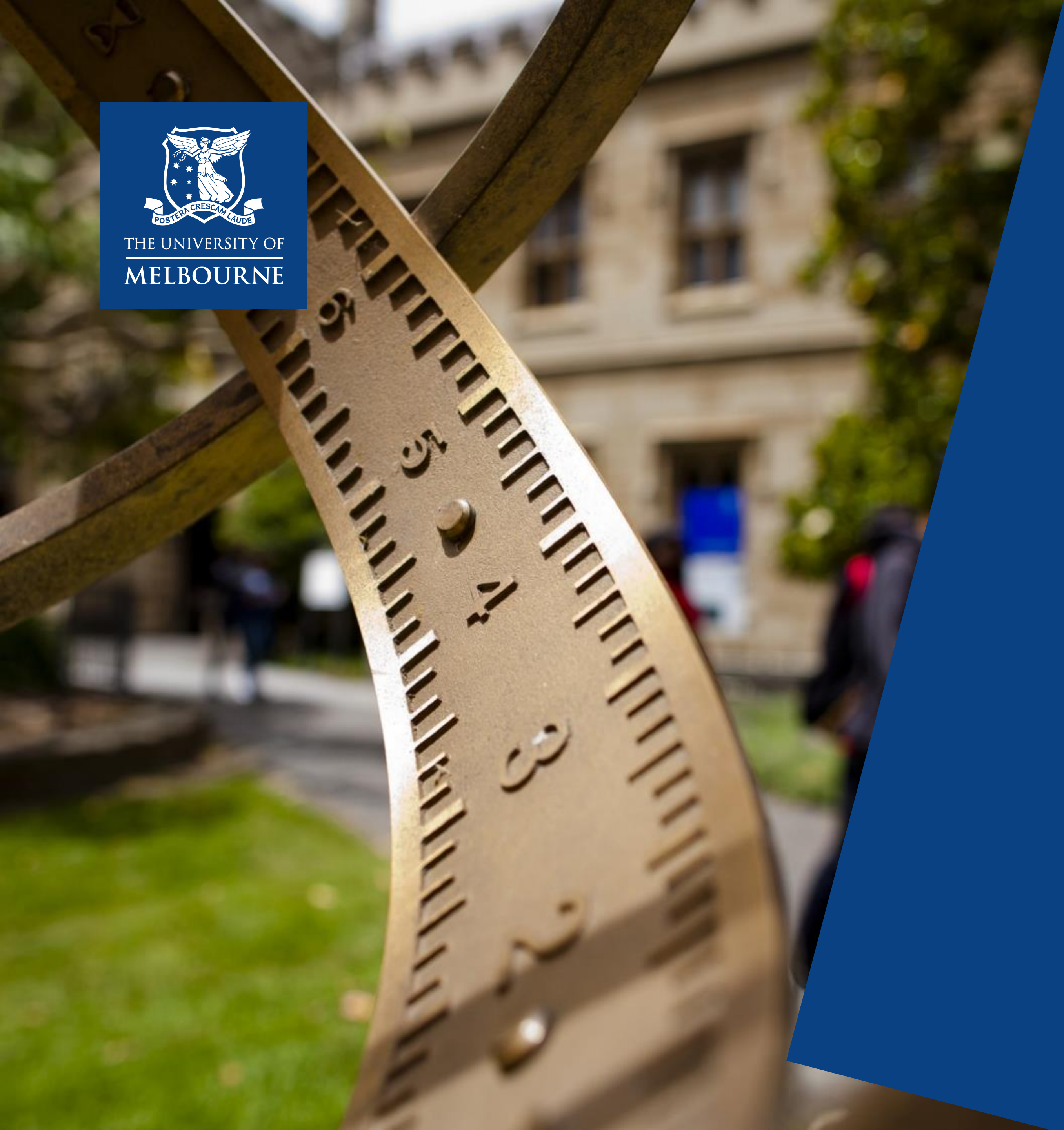
1. 10% of final mark

2. Measuring number of hops. bandwidth, delay, and jitter

3. Report should follow format guide provided in LMS

# Before get started

1. Using lab PC is recommended (all software has been pre-installed)
2. Or you can access digital server to do the experiment,  the guidance of accessing remote Unix server is provided at the end of the slides.
3. Or you can do the experiment under your local computer environment, but I can only provide very limited help. (Less recommended)



# Section 2: Measuring the hop counts

# Section2 Measuring the hop count

**Object:**

Observing the number of intermediate hosts (hops) in the route taken to communicate with remote server.

**Utility tool:**

Traceroute

**Command line:**

OSX/Linux:  traceroute –n w l cis.unimelb.edu.au

Windows:  tracert –d –w l cis.unimelb.edu.au

**Main interest:**

Number of hops it takes to reach the destination server

**Help documentation for traceroute utility:**

OSX: man traceroute

Windows: tracert /?

# Section2 Results analysis

Do not result address to host name

Time out 1 s

utility

hostname

```
C:\Users\24923>tracert -d -w 1 cis.unimelb.edu.au

Tracing route to cis.unimelb.edu.au [128.250.106.72]
over a maximum of 30 hops:

  1     4 ms     4 ms     5 ms  172.18.8.10
  2     5 ms     5 ms     4 ms  172.18.68.33
  3     3 ms     4 ms     3 ms  172.18.68.35
  4     5 ms     4 ms     5 ms  172.18.66.217
  5     6 ms     5 ms     7 ms  172.18.66.234
  6     7 ms     9 ms     4 ms  172.18.66.253
  7     5 ms     5 ms     6 ms  172.19.1.181
  8     4 ms     5 ms     4 ms  172.18.66.137
  9     4 ms     5 ms     5 ms  172.18.86.73
 10     *       19 ms     6 ms  172.18.86.76
 11    20 ms     5 ms     6 ms  128.250.106.72
```

Hops count

Ip address of hops go through

# Section2 Terminologies

**Hops:** ***the computers, routers, or any devices that comes in between the source and the destination.***

**Hostname:** ***In computer networking, a hostname (domain name) is a label that is assigned to a device connected to a computer network. One hostname can map to several Ip addresses, but not the other way round.***

***More information about traceroute:*** https://www.slashroot.in/how-does-traceroute-work-and-examples-using-traceroute-command (not necessary to read, but if you want to get deeper understanding of TTL, ICMP, you could read through that)

# Section2 specification

**2.1 what does the command –n w 1 (equivalently –d –w 1 on windows) mean?**

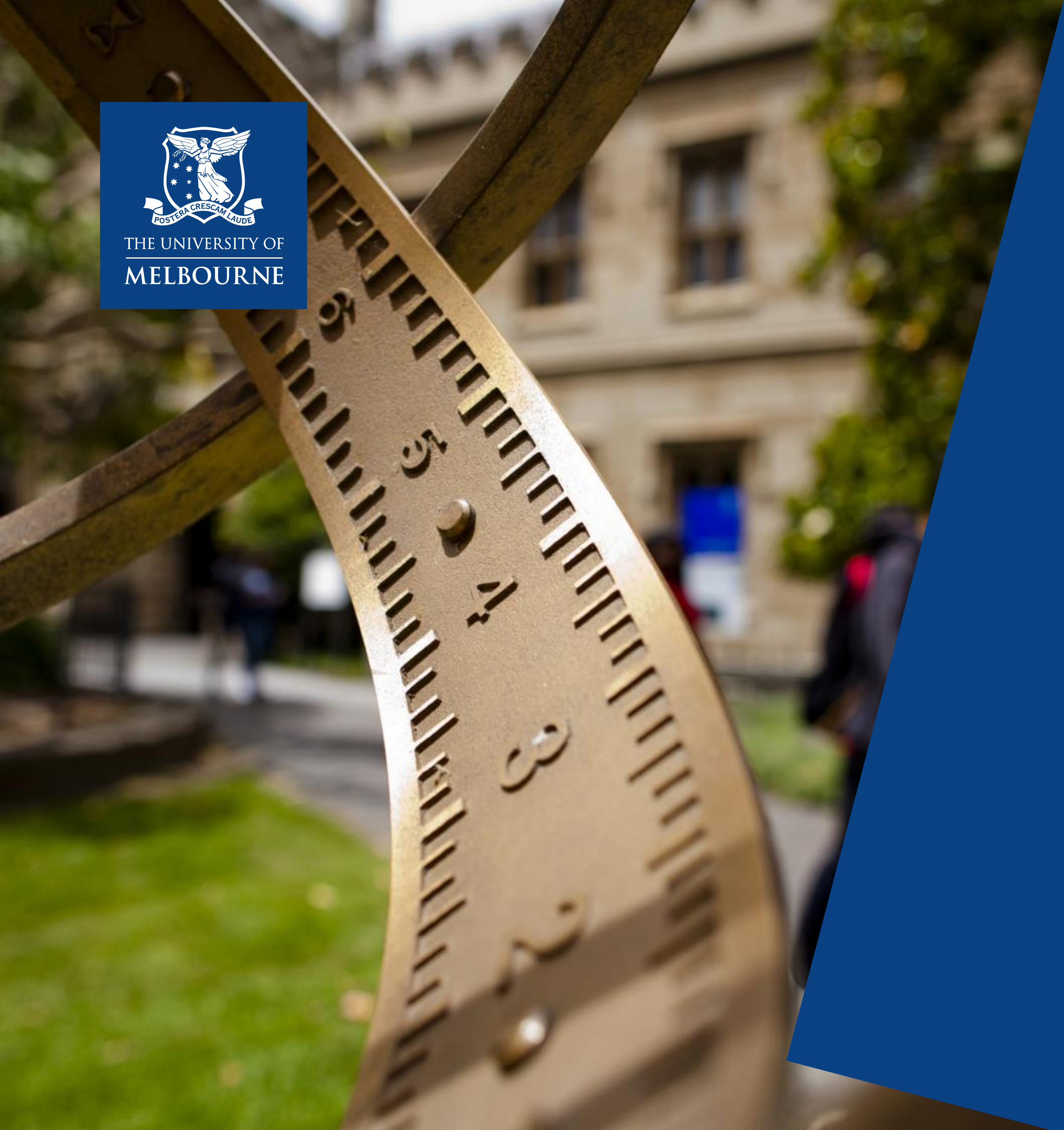
Hint: Please check the help documentation for traceroute utility

**2.2:**

1. Plot hop count versus geographical distance from Melbourne (linear regression might help)
2. Explain your rationale with respect to networking concepts

Hint:

- Do it as soon as possible, otherwise the public server might not be available before due date
- If servers crush, Go to: https://iperf.fr/iperfservers.php and find any other iperf server, you can also deploy you own iperf server.



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# Section 3: Measuring the Delay and jitter

# Section3 Measuring delay and jitter

**Object:**
Measuring the delay and jitter of different hosts

**Method:**
ping

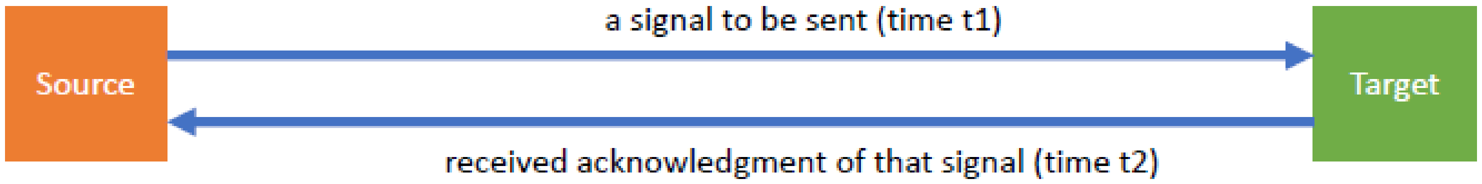
**Command line:**
OSX/Linux: ping –c 3 unimelb.edu.au
Windows: ping unimelb.edu.au

**Main interest:**
Calculate round trip delay(RTT) and jitter

# Section3 Continue..

## Round Trip Delay:

The total time of one source host to send a packet to the target and wait for its acknowledgement to be received




$$RTT = t1 + t2$$

## Jitter:

Jitter is the variation in 'packet' delay. In other words, jitter is measuring the time difference in packet inter-arrival time.



*Cite from: Yiran Ruan, S2 2019, Workshop5, workshop notes, COMP90007 Internet Technology, University of Melbourne, delivered 27 August, 2019*

# Section2 Results analysis

utility

hostname

```
C:\Users\24923>ping unimelb.edu.au

Pinging unimelb.edu.au [172.20.0.43] with 32 bytes of data:
Reply from 172.20.0.43: bytes=32 time=4ms TTL=250
Reply from 172.20.0.43: bytes=32 time=4ms TTL=250
Reply from 172.20.0.43: bytes=32 time=5ms TTL=250
Reply from 172.20.0.43: bytes=32 time=7ms TTL=250

Ping statistics for 172.20.0.43:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 4ms, Maximum = 7ms, Average = 5ms
```

RTT delay

Some statistics

# Section3 Continue..

## Calculate Round Trip Delay:

Calculate the average of the delay

## Calculate Jitter:

$$\sigma = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(x_i - \bar{x})^2}$$

N: number of data
X: mean of set of data

**If there're no difference between delay**

**For macOS/Linux:**
Use sqrt(((mdev1)^2 + (mdev2)^2 + (mdev3)^2) / 3 )

**For windows, download hrPing:**
hrping [host address]

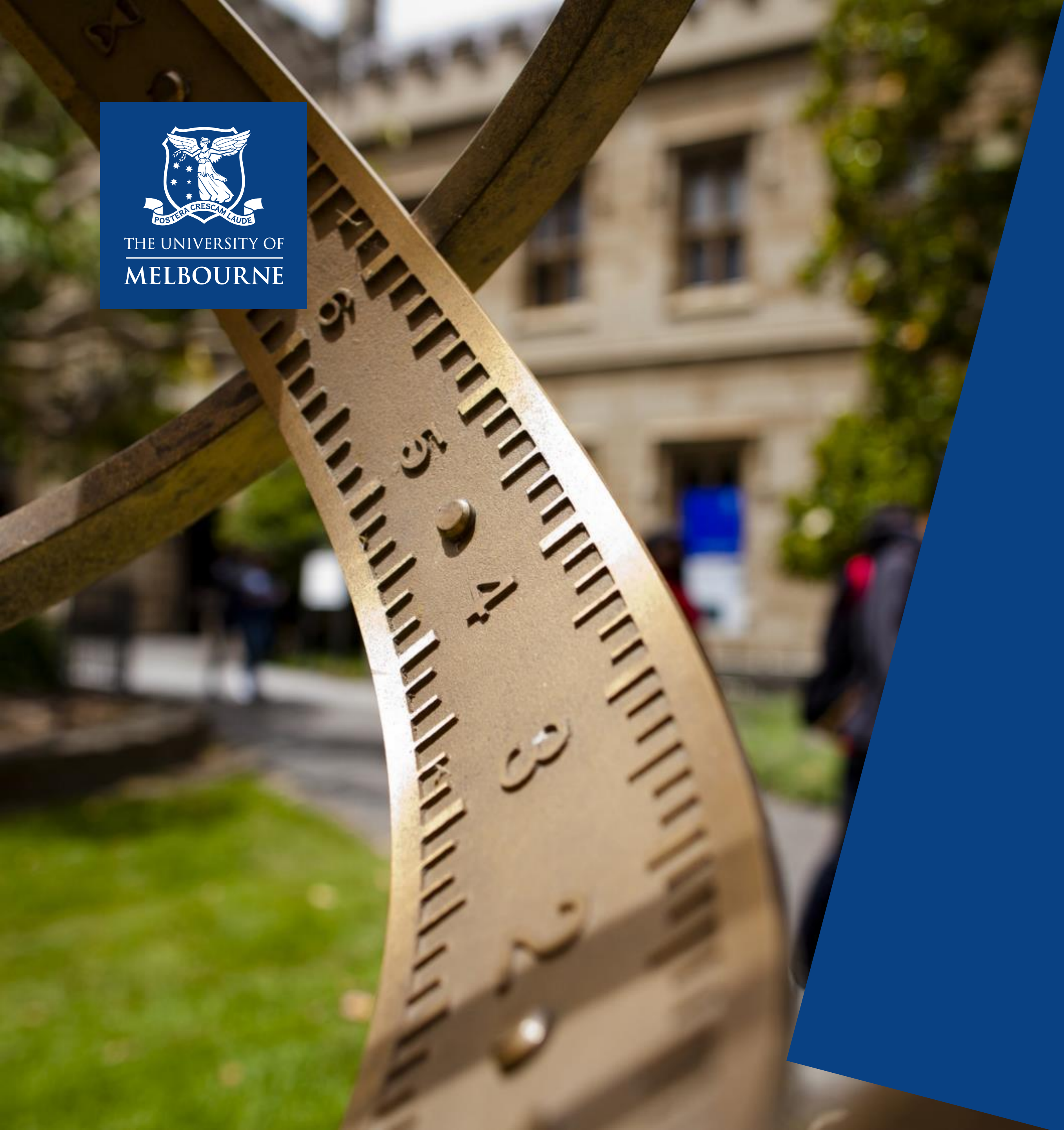
# Section3 Specification

## 3.1 Calculate round trip delay (RTT):

- Make three delay measurements(run command three times) for each server
- Calculate average round-trip delay and jitter
- Plot RTT versus the physical geographical distance to the server

## 3.2 Discuss the plot you get

- Explain your result with reference to the network environment
  - Upload, download speed
  - User sharing the network
  - Load network through other apps



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# Section 4: Measuring the bandwidth-delay product

# Section4 Measure the bandwidth*delay

## Object:
Measure the bandwidth of different hosts in order to determine the bandwidth-delay product

## Method:
iperf (download from http://iperf.fr)
Use client mode (-c)

## Command line:
iperf –c [hostname]
Or iperf3 –c [hostname] –p 5002

If possible , try to use iperf instead of iperf3

## Main interest:
Calculate product of bandwidth and delay

# Section4 Results

utility

Client mode

Hostname

```
C:\Users\24923>iperf -c iperf.he.net
------------------------------------------------------------
Client connecting to iperf.he.net, TCP port 5001
TCP window size: 63.0 KByte (default)
------------------------------------------------------------
[  3] local 10.9.131.171 port 54511 connected with 216.218.227.10 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-10.2 sec  4.00 MBytes  3.29 Mbits/sec
```

Bandwidth

*Hint: if you use 'iperf3', it will pops two bandwidth: sender and receiver. You should the* ***<u>sender</u>*** *one.*

# Section4 Specification

**4.1 what does the bandwidth-delay product tells us about the networks? Take three measurements for each host.**

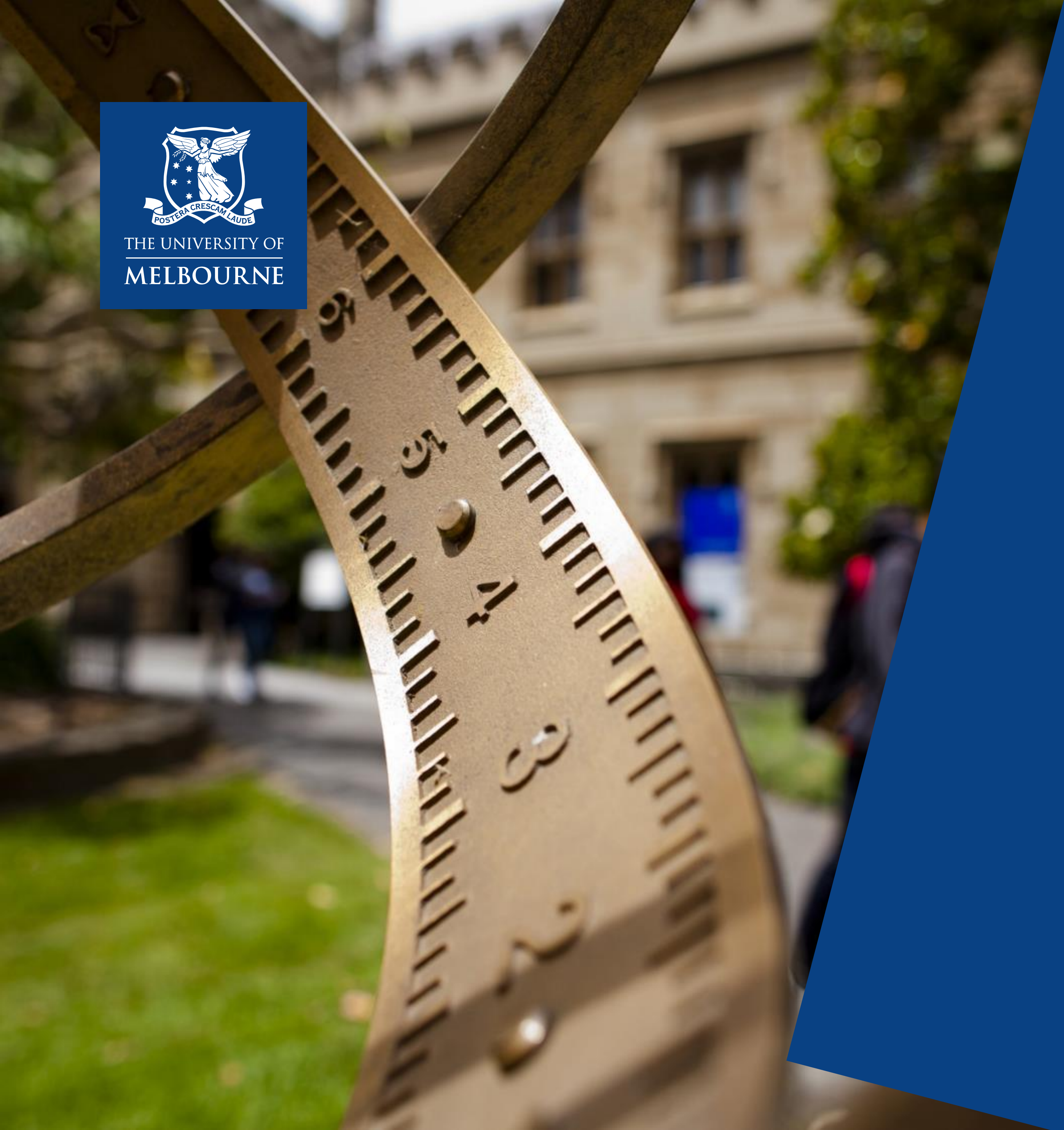
**4.2 Take the mean bandwidth and calculate the bandwidth-delay product in kilobits.**

- Use average of RTT from ping test as delay time
- Plot a bard char for each host as result
- Explain result with reference to your network

**4.3 plot bandwidth-delay product versus the hop count**

- Discuss if there’s any correlation

**4.4 What factors may affect the accuracy and reliability of your results (bandwidth, delay, jitter)?, How might you improve upon these?**




# Connect to remote server

# Remote server access

Note: If you decide to use Lab PC, then you can skip this section. But if you decide to use your own laptop to do the project, the easiest way is connecting to remote Unix server.

**To connect to remote server:**

ssh [username]@digitalis.eng.unimelb.edu.au

Or

ssh [username]@digitalis2.eng.unimelb.edu.au

# Final words

1. When you do the tests, remember to screenshot the results. All the results should be placed in appendix, all the plots should be placed in the main body of your result
2. Work in a consistent networking environment
3. Submit your report as a PDF file (A4, 10pt font, 1.5 lines-spacing, min 3.8cm left and right margin)
4. Use format guide document provided in LMS
5. Maximum 10 page excluding appendix
6. Information provided in this slides are simplified, please refer to the document provided in LMS for detail requirement