TÉCNICO LISBOA

1st Mini-Project: File Transfer

Reliable Data Transfer

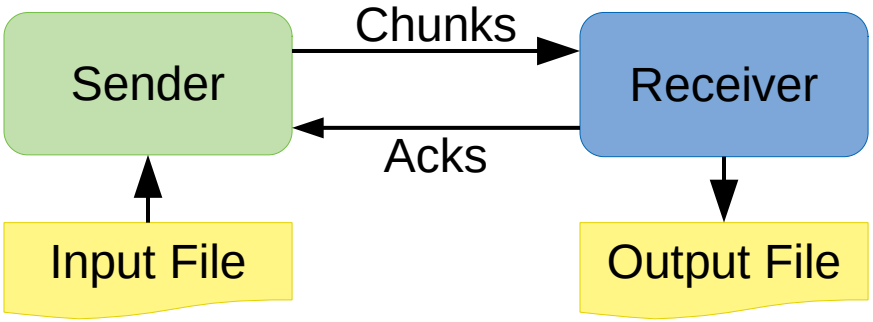
Overview

What you'll learn:

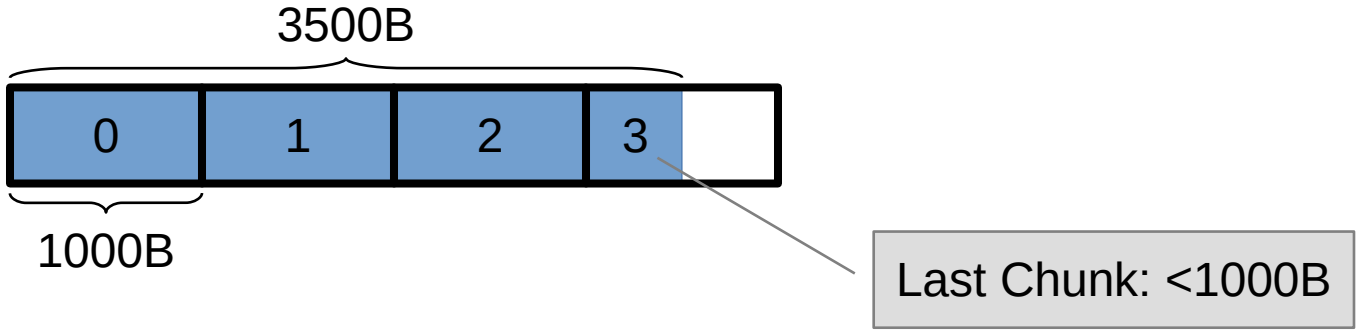
- Reliable data xfer
- UDP sockets

Create file transfer system

- **File Sender**
- **File Receiver**

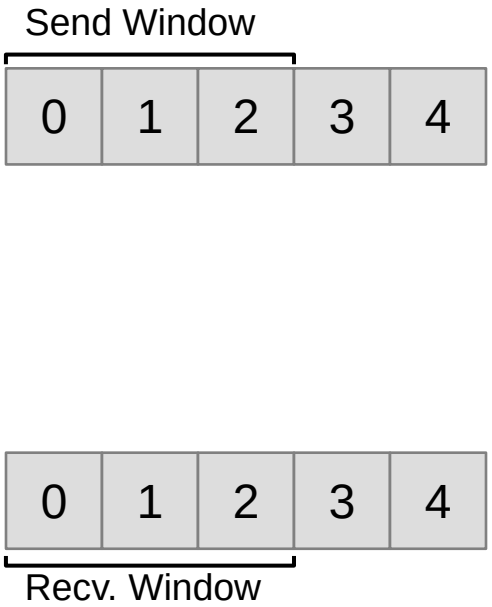


Overview: Files to Chunks

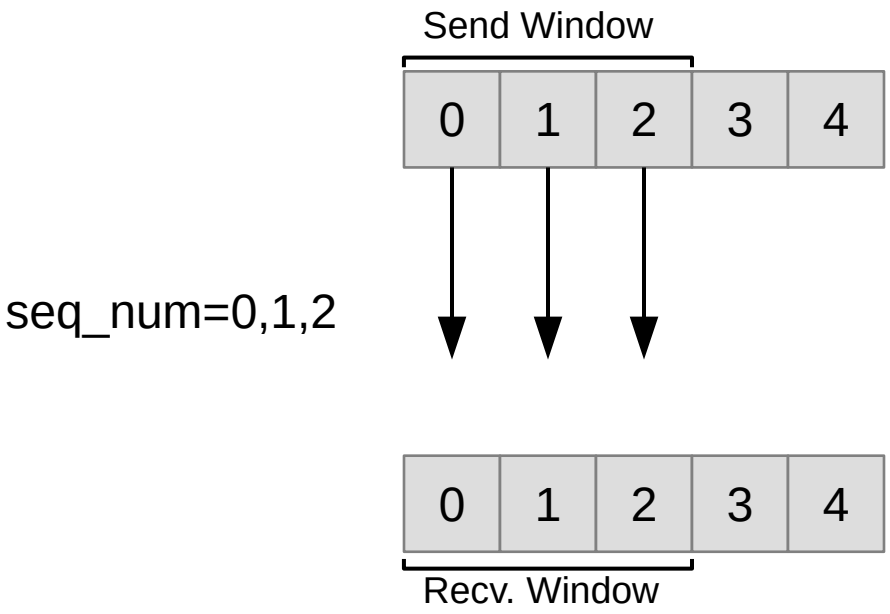



```
typedef struct __attribute__((__packed__)) data_pkt_t {
  uint32_t seq_num;
  char data[1000];
} data_pkt_t;

typedef struct __attribute__((__packed__)) ack_pkt_t {
  uint32_t seq_num;
  uint32_t selective_acks;
} ack_pkt_t;
```

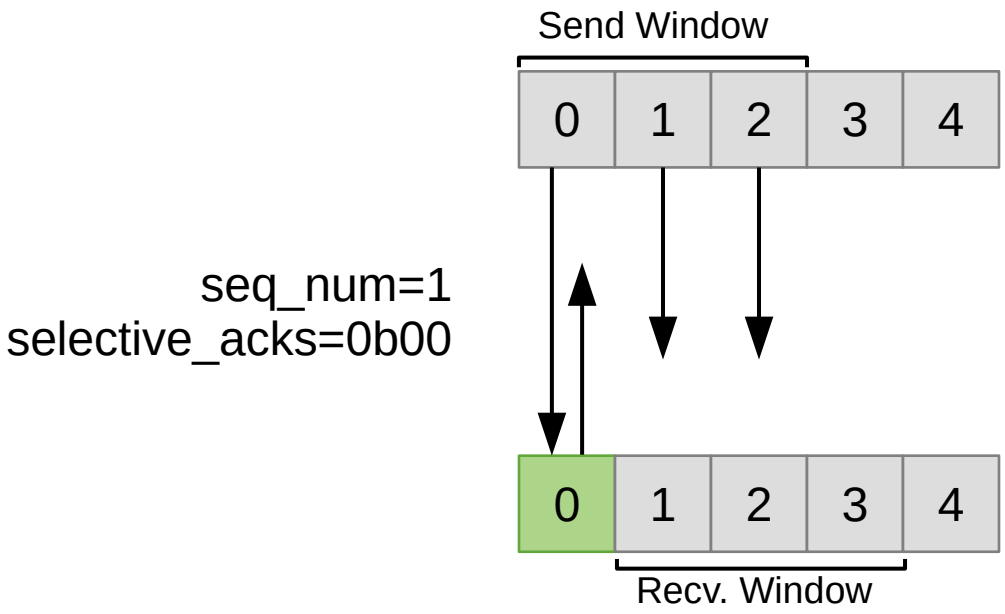
Overview: Reliable Data Transfer



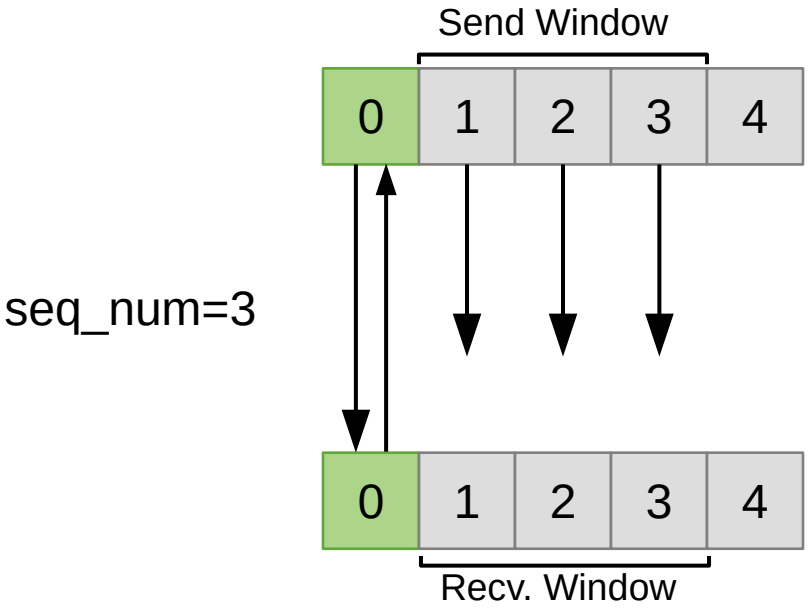
Overview: Reliable Data Transfer



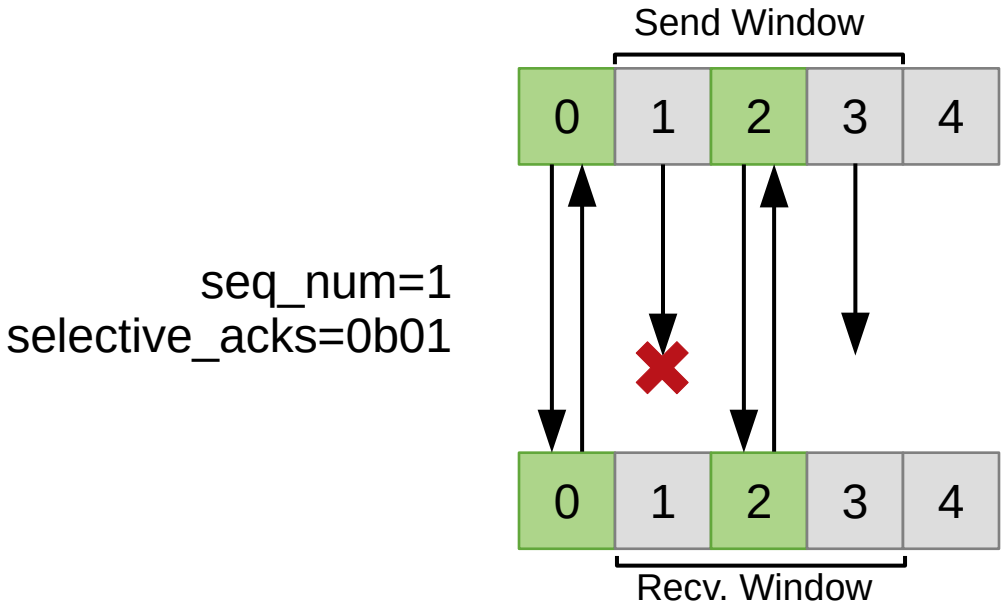
Overview: Reliable Data Transfer



Overview: Reliable Data Transfer

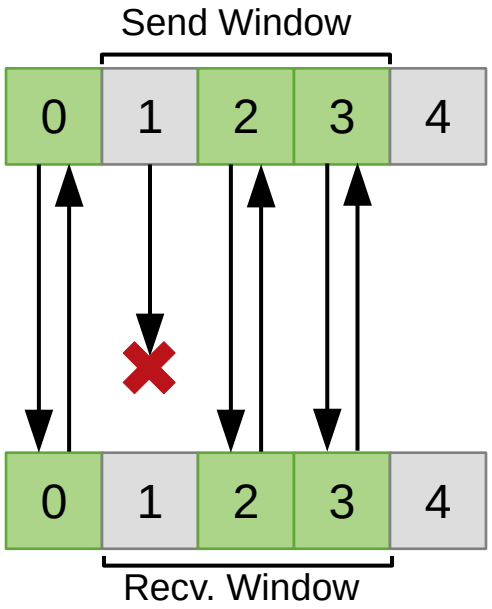


Overview: Reliable Data Transfer



Overview: Reliable Data Transfer

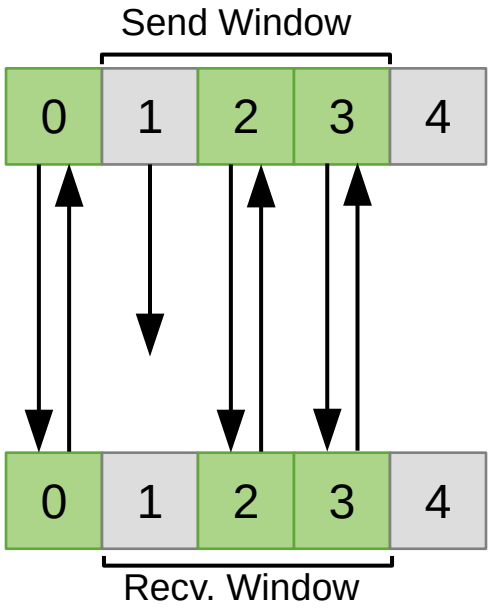
seq_num=1
selective_acks=0b11



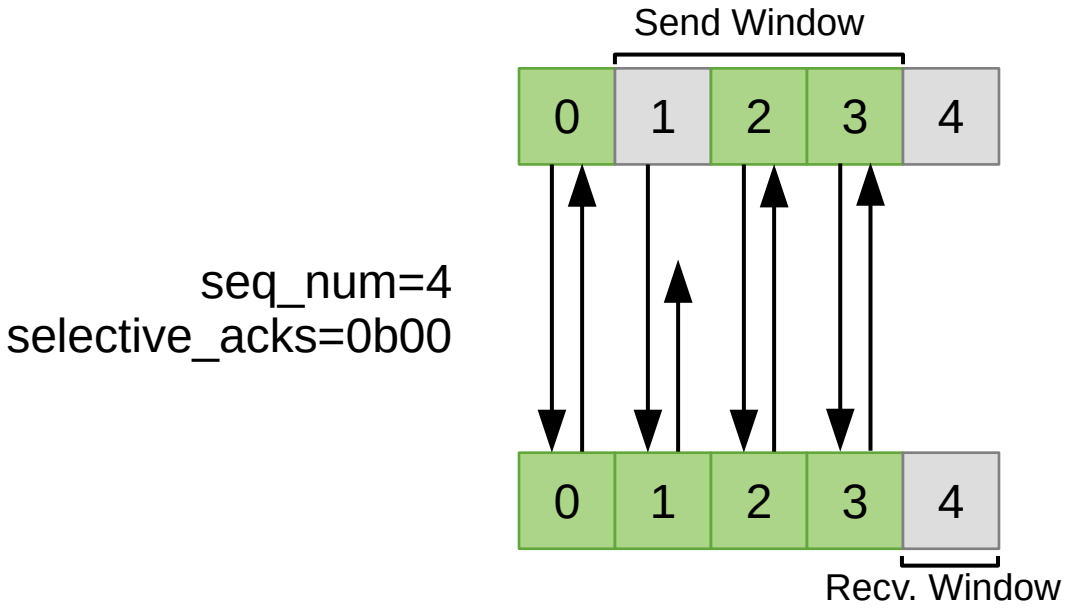
Overview: Reliable Data Transfer

***** 1s Later *****

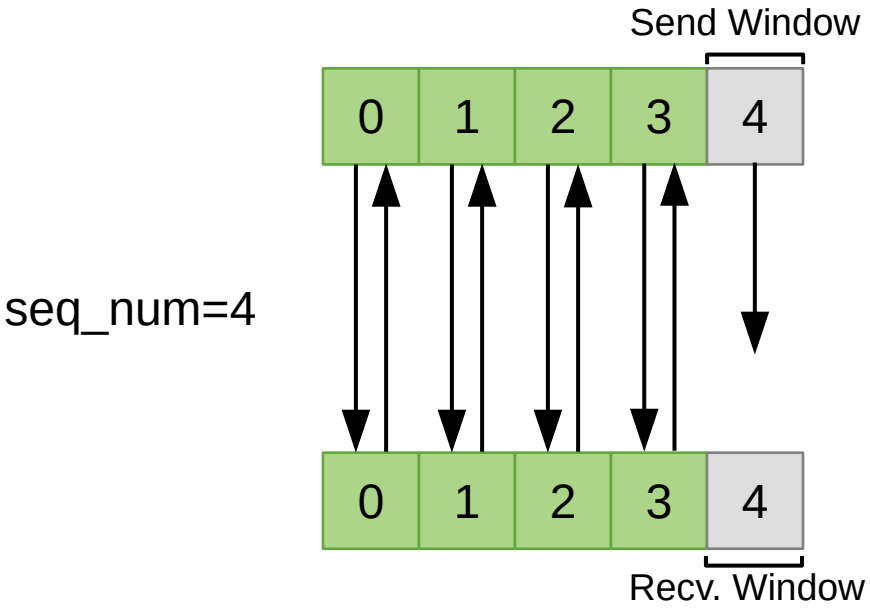
seq_num=1



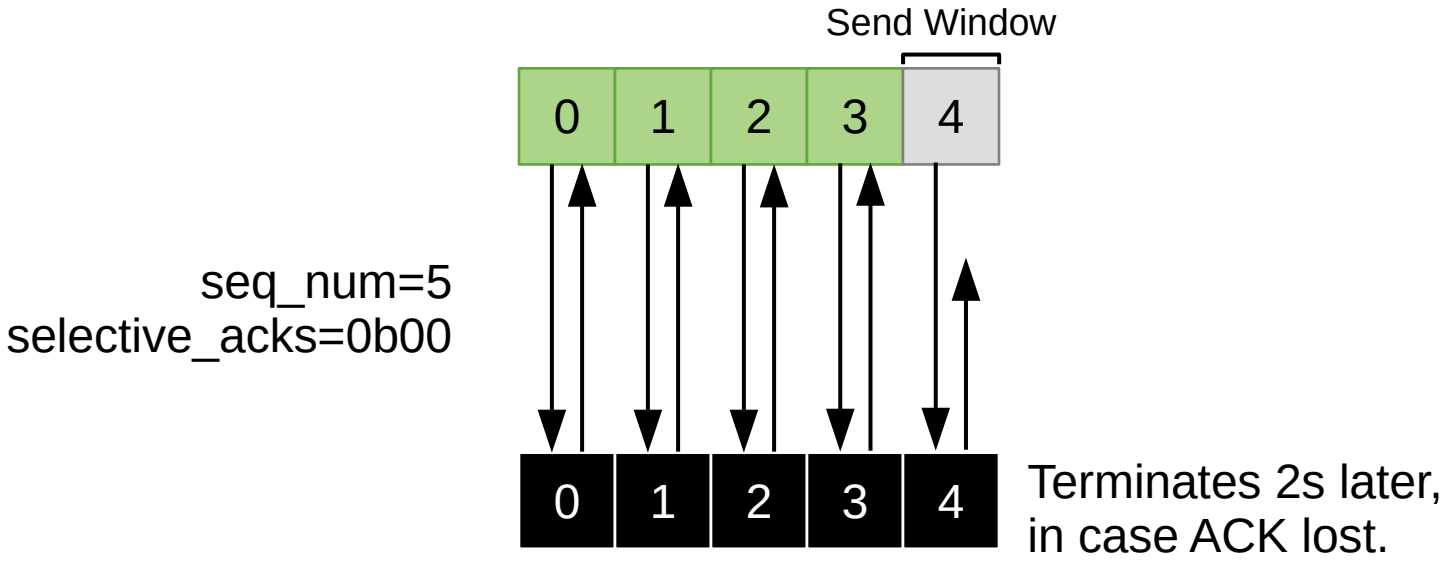
Overview: Reliable Data Transfer



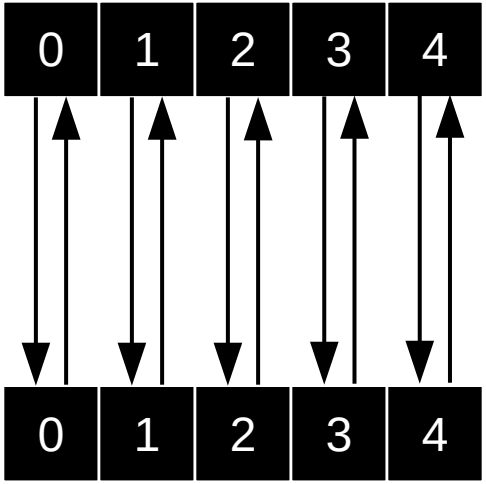
Overview: Reliable Data Transfer



Overview: Reliable Data Transfer



Overview: Reliable Data Transfer



Terminates immediately.

Terminates 2s later,
in case ACK lost.

Overview: Reliable Data Transfer

Notes

- Chunks start at 0
- Fields in network order
  - Use htonl(), ntohl()
- Ack = recv. window
  - seq_num = base
  - selective_acks skips first (will always be 0)

RDT Modes and Window Size

- Stop-and-Wait
  - Send = 1, Receive = 1
- Go-Back-N
  - Send = N, Receive = 1
- Selective Repeat
  - Send = N, Receive = M <= N

File Transfer in Action

```
project-reliable-xfer : bash — Konsole
File  Edit  View  Bookmarks  Settings  Help
david@Tuxedo:~/project-reliable-xfer$ echo Test > send.dat
david@Tuxedo:~/project-reliable-xfer$ ./file-sender send.dat localhost 1234 1
Sending segment 0.
Received ACK 1 / 00000000.
david@Tuxedo:~/project-reliable-xfer$
```

```
project-reliable-xfer : bash — Konsole <2>
File  Edit  View  Bookmarks  Settings  Help
david@Tuxedo:~/project-reliable-xfer$ ./file-receiver receive.dat 1234 1
Receiving on port: 1234
Received segment 0.
Sending ACK 1 / 00000000.
david@Tuxedo:~/project-reliable-xfer$ cat receive.dat
Test
david@Tuxedo:~/project-reliable-xfer$
```

Submission

- Develop your code on:
  https://git.rnl.tecnico.ulisboa.pt/
- Include:
  - Code
  - Makefile in base folder
  - No build artifacts
- Tag submission as project1-submission:
  ```
  :~$ git tag project1-submission
  :~$ git push origin project1-submission
  ```
- Must build with **`make`**
  - Generate <u>file-sender</u> & <u>file-receiver</u>

```
:~$ git clone <repo URL> .
:~$ git checkout project1-submission
:~$ ls
Makefile file-receiver.c file-sender.c
:~$ make
:~$ ls
Makefile file-receiver.c file-receiver
file-sender.c file-sender
```

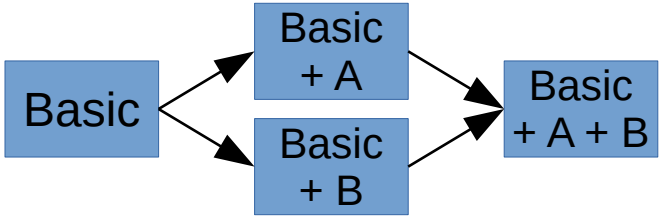
Nightly Builds

- Coming soon to a repo near you…
- Runs nightly
  - Simple tests – does not preclude running your own
  - Runs on master branch and generates build-report.md
    - Don’t forget to pull
  - <u>On request:</u> must delete report and push to rerun next time

GIT Primer

- Git is a distributed version control system
  - Tracks versions of code
  - Tracks/merges branches
  - Ubiquitous

- Creates a version graph with branches diverging and merging.

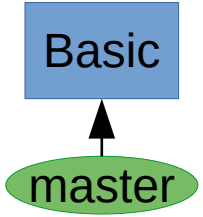


- Synchronizes a local repo with a remote repo.

GIT Primer – Walk-through

```
:~$
```

Remote Repo:

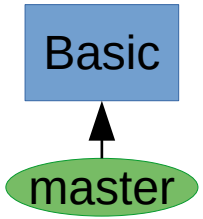


Local Repo:

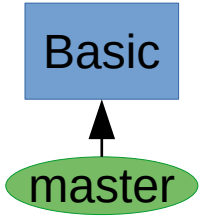
GIT Primer – Walk-through

```
:~$ git clone <url>
```

Remote Repo:



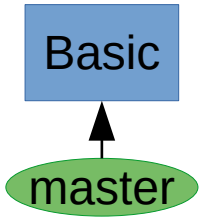
Local Repo:



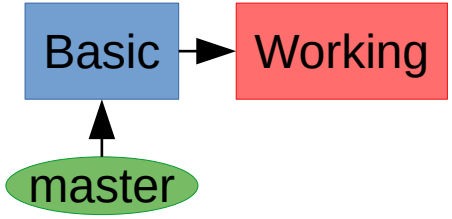
GIT Primer – Walk-through

```
:~$ git clone <url>
:~$ echo stuff > A.c
:~$ git status
Untracked files: A.c

:~$ git add A.c
:~$ git status
Changes to be committed:
        new file:   A.c
```

Remote Repo:



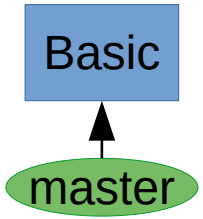
Local Repo:



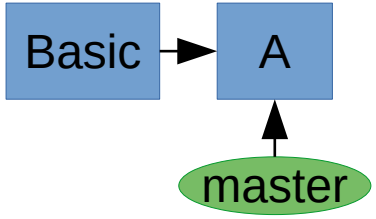
GIT Primer – Walk-through

```
:~$ git clone <url>
:~$ echo stuff > A.c
:~$ git add A.c
:~$ git commit -m “Did A”
:~$ git status
# ahead of 'origin/master' by 1 commit.
nothing to commit
```

Remote Repo:



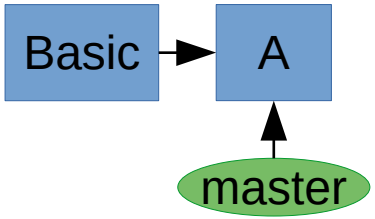
Local Repo:



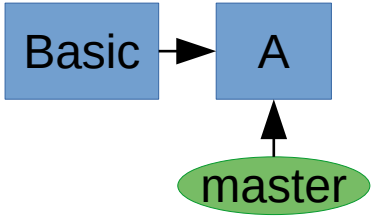
GIT Primer – Walk-through

```
:~$ git clone <url>
:~$ echo stuff > A.c
:~$ git add A.c
:~$ git commit -m “Did A”
:~$ git push
```

Remote Repo:



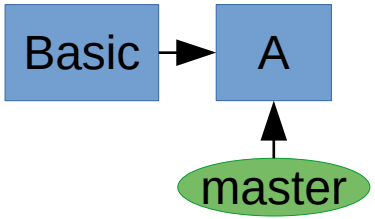
Local Repo:



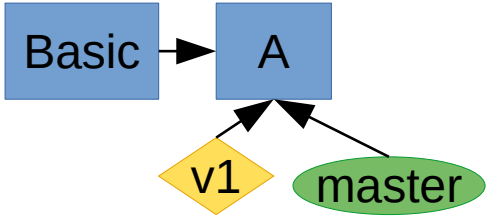
GIT Primer – Walk-through

```
:~$ git clone <url>
:~$ echo stuff > A.c
:~$ git add A.c
:~$ git commit -m “Did A”
:~$ git push
:~$ git tag v1
```

Remote Repo:



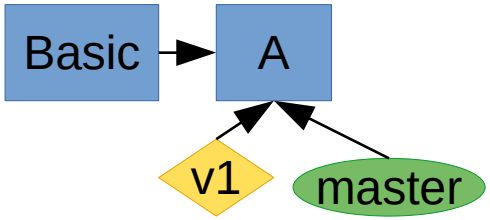
Local Repo:



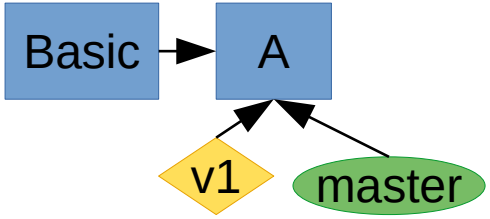
GIT Primer – Walk-through

```
:~$ git clone <url>
:~$ echo stuff > A.c
:~$ git add A.c
:~$ git commit -m “Did A”
:~$ git push
:~$ git tag v1
:~$ git push origin v1
```

Remote Repo:



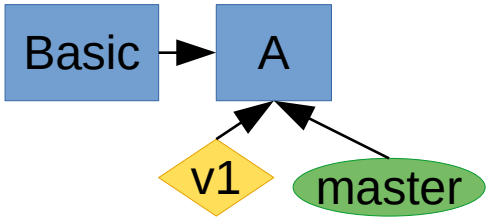
Local Repo:



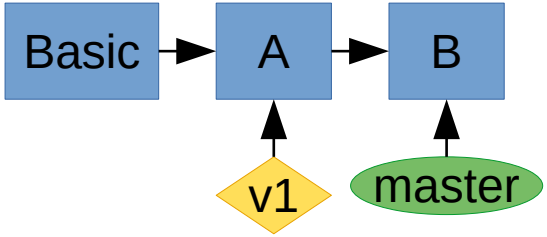
GIT Primer – Walk-through

```
:~$ git clone <url>
:~$ echo stuff > A.c
:~$ git add A.c
:~$ git commit -m “Did A”
:~$ git push
:~$ git tag v1
:~$ git push origin v1
:~$ echo stuff > B.c
:~$ git add B.c
:~$ git commit -m “Did B”
```

Remote Repo:



Local Repo:



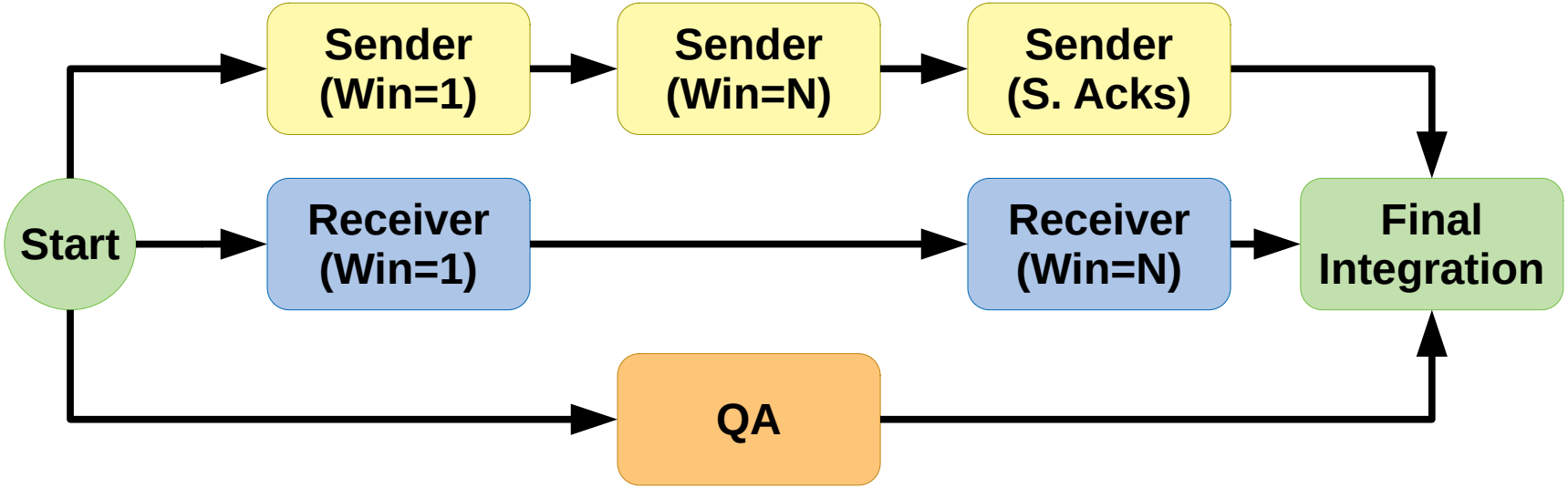
GIT Primer – More Info

- Quick reference: `git help <command>`
- Cheat sheet: https://about.gitlab.com/images/press/git-cheat-sheet.pdf
- Branching and Merging: https://git-scm.com/book/en/v2/Git-Branching-Basic-Branching-and-Merging
- Full Docs: https://git-scm.com/doc

Advice: Debugging

- Standard output/error will be ignored during grading
  - `printf(…)`
- Debug tools also available
  - **log-packets.c**: Packet logging & fault injection
  - **generate-msc.sh**: Log analysis & MSC generation (uses mscgen package)
- Testing
  - Look into **run.sh** for ideas.

Advice: Task Breakdown



Advice: MSC Generation

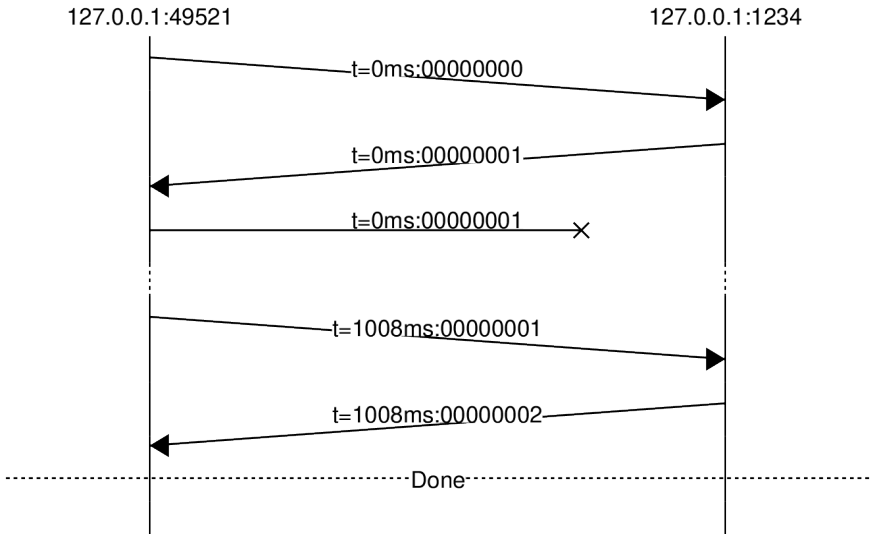
```
gcc -shared -fPIC -Wall -O0 -g \
    -o log-packets.so log-packets.c -ldl

LD_PRELOAD = "./log-packets.so" \
    SEND_DELAY="500" \
    DROP_PATTERN="01" \
    PACKET_LOG="sender.log" \
    ./file-sender …

./generate-msc.sh msc.eps sender.log receiver.log
```

See: run.sh

Advice: MSCs

Stop-and-Wait

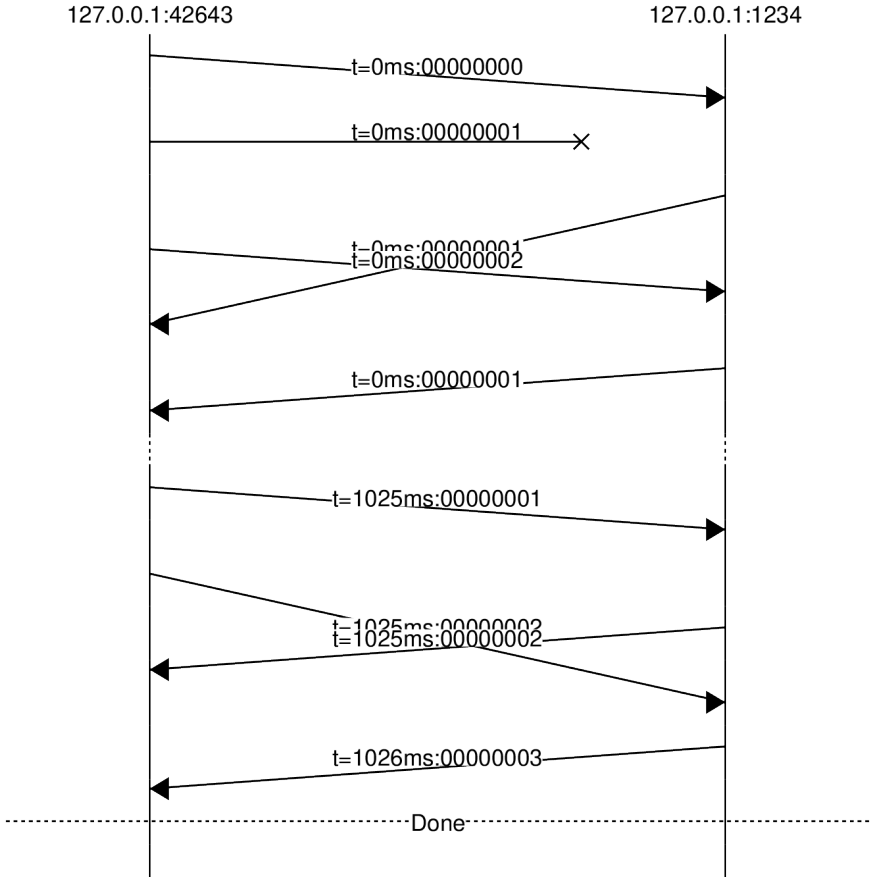
- 2 Chunks
- Sender
  - DROP_PATTERN="01"
  - Send Window = 1
- Receiver
  - DROP_PATTERN=""
  - Receive Window = 1



Advice: MSCs

Go-Back-N

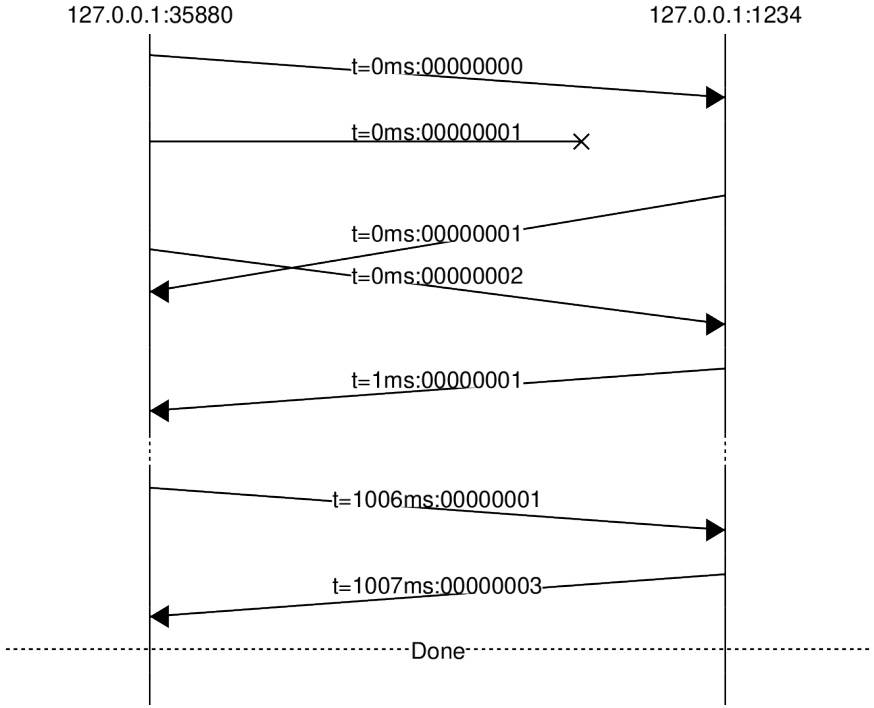
- 3 Chunks
- Sender
  - DROP_PATTERN="01"
  - Send Window = 3
- Receiver
  - DROP_PATTERN=""
  - Receive Window = 1



Advice: MSCs

Selective-Repeat

- 3 Chunks
- Sender
  - DROP_PATTERN="01"
  - Send Window = 3
- Receiver
  - DROP_PATTERN=""
  - Receive Window = 3



Advice: MSCs

Improv

- How Many Chunks?
- Sender
  - DROP_PATTERN="?"
  - Send Window = ?
- Receiver
  - DROP_PATTERN="?"
  - Receive Window = ?

?