The basics of file systems

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JET BRAINS

Implementing a connection pool

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    if err := upw.receiveResponse(); err != nil {
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    upw.currentOffset = chunkEnd
    return n, nil
}
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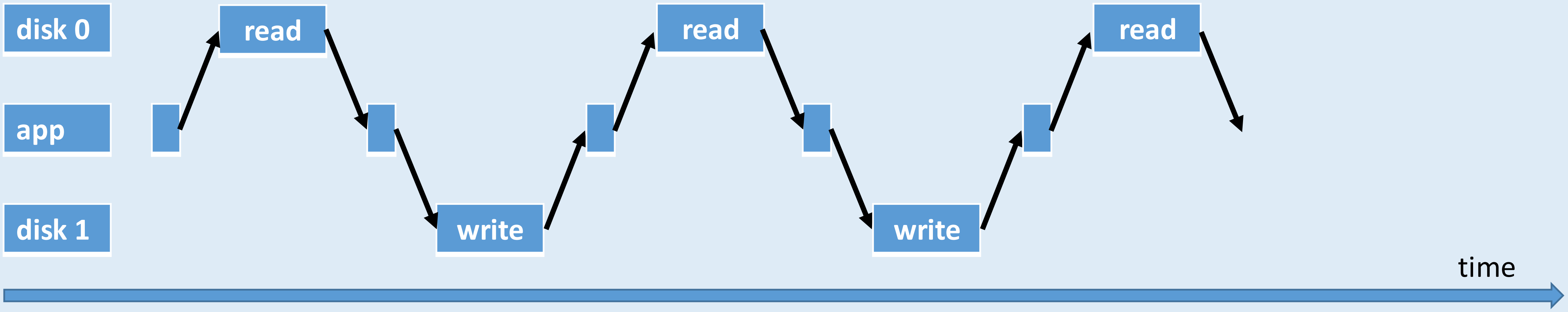
Synchronous and asynchronous IO, pipelining and multiplexing

Consider a naïve implementation of a routine that copies a file from one disk to another:

```
while (!done) {
  r = read(fd_in, buf, sizeof(buf));
  r0 = write(fd_out, buf, r);
  ...
}
```

Let us draw time intervals when each disk is accessed:



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One more reason why this is a must:

- The Linux kernel tracks the average speed of writes to a connection, and will not grow socket buffers if there are not enough writes on average. Connections with few writes on average will stay slow.

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One may try to solve is this way:

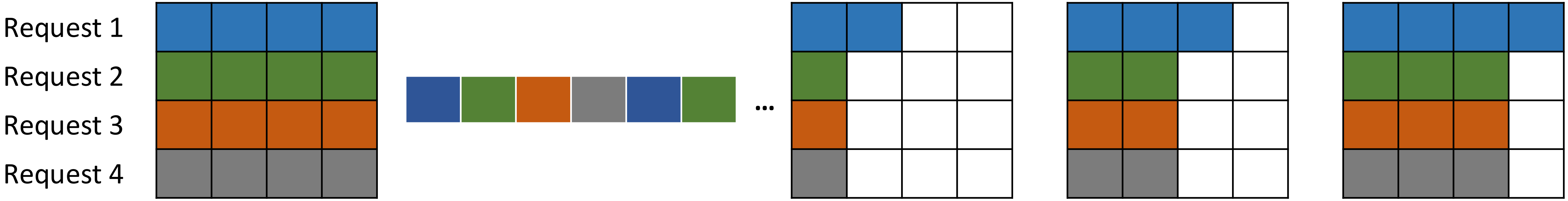
- suppose a chunk has 32M worth of data,
- let us issue 32 `WriteAt()`s, each with 1M payload,
- let us have 32 connections to send all `WriteAt()`s in parallel.

How the network interacts with concurrent requests

A client that send multiple requests over multiple network connections

The network

The server's request queue



From the point of view of the network different connections are independent streams of bytes and each must get an equal share of the bandwidth.

The server needs a lot of RAM to buffer all incoming requests. If it does not, it will throttle the client.

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In go one can achieve this by assigning 3 goroutines to each connection:

1. a goroutine that writes requests to the connection,
2. a goroutine that receives requests from the connection,
3. a control goroutine that closes the connection and cancels the context of the reader and the writer.

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This pairs nicely with writer goroutines.

```
type ConnGroup struct {
   …
   messages chan *message
}

func (c *Conn) writerGor(ctx context.Context) {
   for req := range c.connGroup.messages {
      … send the request …
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}

func (cg *ConnGroup) SendMessage(ctx context.Context, msg
*message) (err error) {
   select {
   case cg.messages <- message:
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```

A connection sends a message as soon as it becomes available.

The channel throttles writers. If all connections are busy then `SendMessage()` is put to sleep until there is a connection that can send more requests.

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Idea: a response is a message "this is the result of request #N".

Note: this way responses may use any connection in the pool. Compare this to IP packets in a TCP connection using any available path between endpoints.

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This introduces a problem, though: a write #K may fail, but the client sends writes # K+1, K+2 and so on without waiting for a reply to write #K. The server must be able to handle writes to an already failed upload.