CMPT 373
Software Development Methods

Design

Nick Sumner
wsumner@sfu.ca

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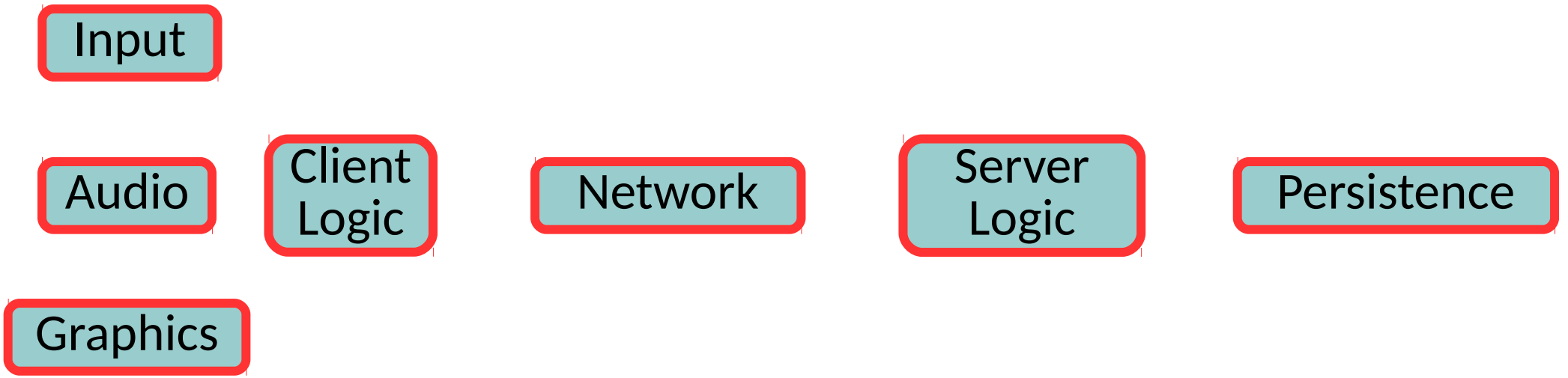

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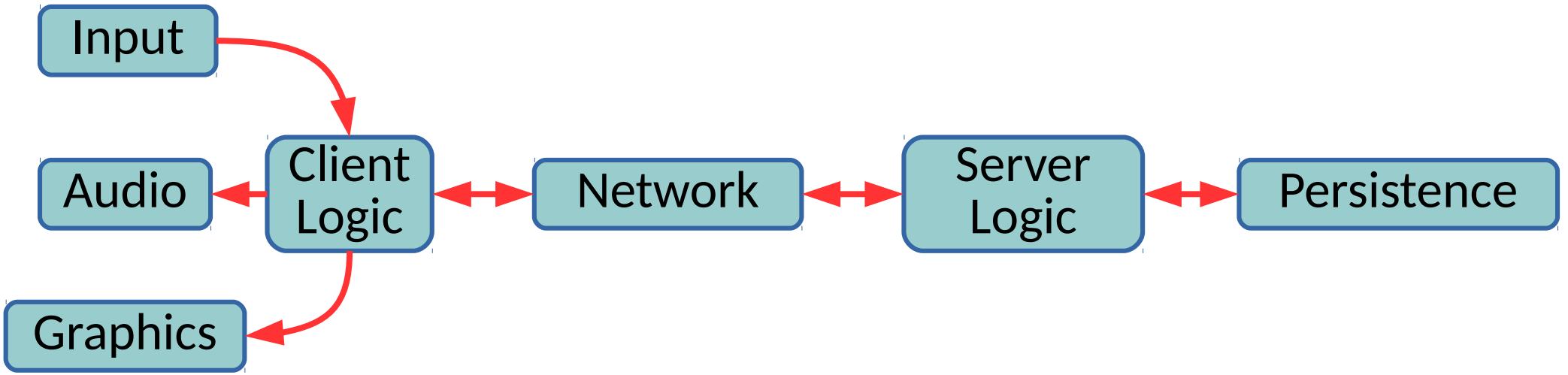

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} *architecture*

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What is an abstraction?

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```
Server server{port};
while (true) {
  auto incoming = server.receive();
  ...
  server.send(outgoing);
}
```

What does the networking library that I gave to you expose/hide?

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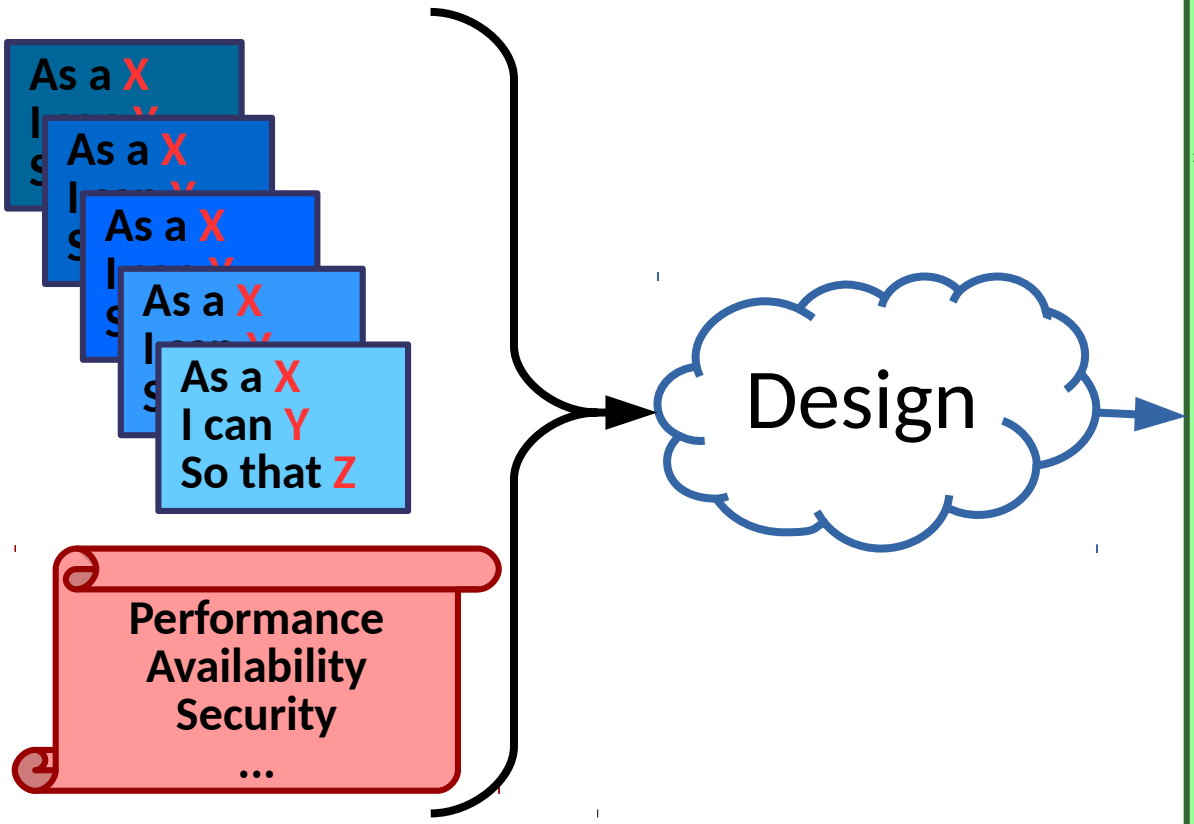
Is design UML?

Is UML design?

Why does design matter?

Why does design matter?

- Translating requirements and stories to code




```
////////////////////////////////////////////////////////////////////////////
//                          Single Threaded Networking
//
// This file is distributed under the MIT License. See the LICENSE file
// for details.
////////////////////////////////////////////////////////////////////////////

#include <unistd.h>
#include "ChatWindow.h"
#include "Client.h"

int
main(int argc, char* argv[]) {
  if (argc < 3) {
    printf("Usage:\n%s <ip address> <port>\ne.g. %s localhost 4002\n",
           argv[0], argv[0]);
    return 1;
  }

  networking::Client client{argv[1], argv[2]};

  bool done = false;
  auto onTextEntry = [&done, &client] (std::string text) {
    if ("exit" == text || "quit" == text) {
      done = true;
    } else {
      client.send(text);
    }
  };

  ChatWindow chatWindow(onTextEntry);
  while (!done && !client.isDisconnected()) {
    try {
      client.update();
    } catch (std::exception& e) {
      chatWindow.displayText("Exception from Client update:");
      chatWindow.displayText(e.what());
      done = true;
    }

    auto response = client.receive();
    if (!response.empty()) {
      chatWindow.displayText(response);
    }
    chatWindow.update();
  }

  return 0;
}
```

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- Translating requirements and stories to code
- Understandability

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How much time do professional programmers spend reading code?

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- Performance & reliability

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  - Requirements will change
  - Your code may outlast your time at a company
- Once software is too complex to reason about, it is too late

What makes a design good?

- It identifies & manages ***complexity***

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    [Watch "Simple Made Easy" for one interesting perspective]

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    [Watch “Simple Made Easy” for one interesting perspective]
  - One other heuristic is risk of *change*

What makes a design good?

Broadly

- Divides the system into independent components

What makes a design good?

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- Divides the system into independent components
- Makes it easy for developers to get their jobs done

What makes a design good?

- Not clever

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- Not clever!

```
int x = foo(bar(baz(bam(a), b), c), d);
```

What makes a design good?

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```

```
// this subroutine is called thousands of times.
// use longjmp instead of loops to increase speed.

void
calculate(struct salesinfo* sales){
  jmp_buf buffer;
  int i=setjmp(buffer);
  if (!(i<sales->count)) RETURN_NOTHING;
  addvaluetosubtotal(sales->values[i]);
  if (i<sales->count) longjmp(buffer,i+1);
}
```

http://thedailywtf.com/articles/Longjmp--FOR-SPEED!!!

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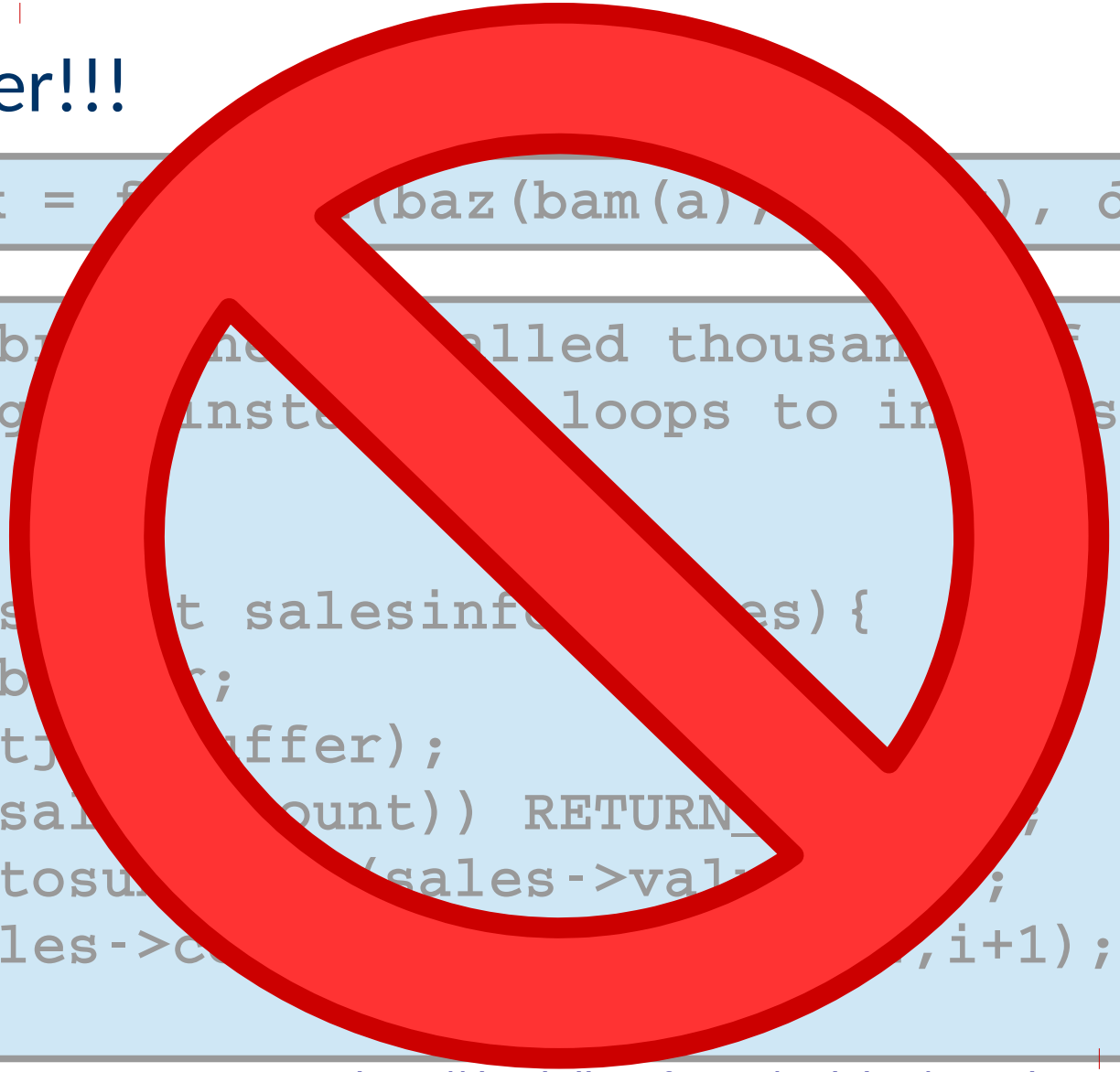

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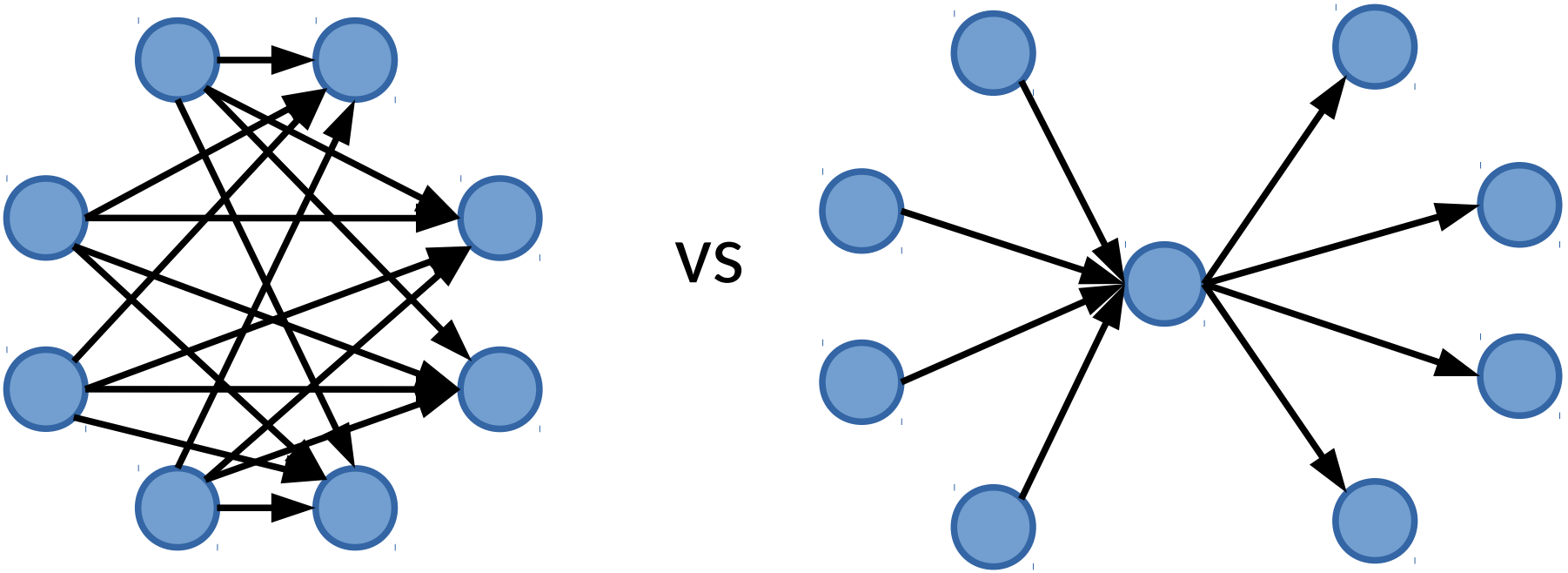

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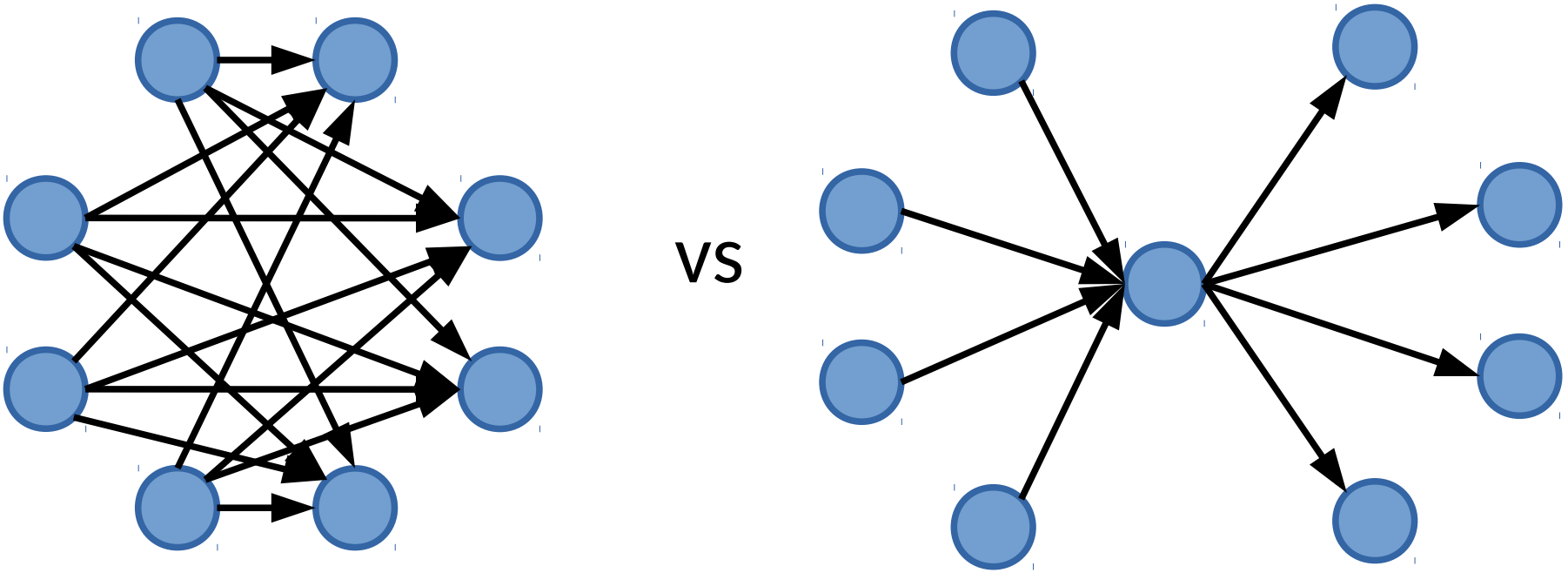


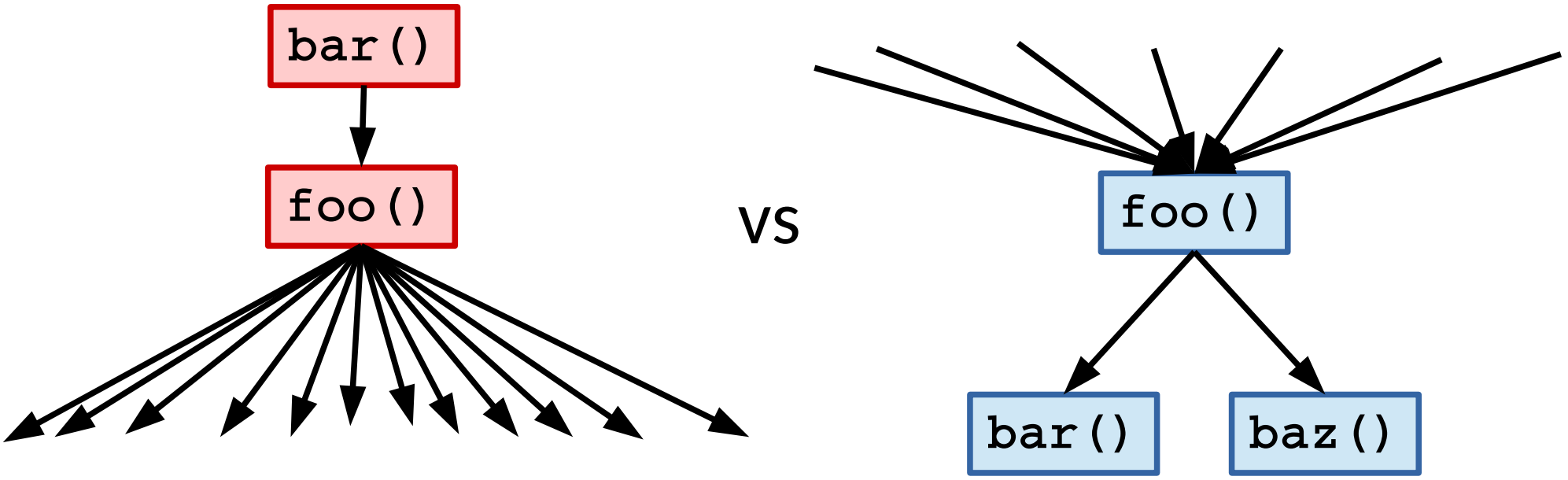
Why?

What makes a design good?

- Not clever
- Loose coupling
  - Content (accessing implementation of another component)
  - Common global data
  - Subclassing
  - Temporal
  - Passing data to/from each other
  - Independence

What makes a design good?

- Not clever
- Loose coupling
- High fan in / low fan out



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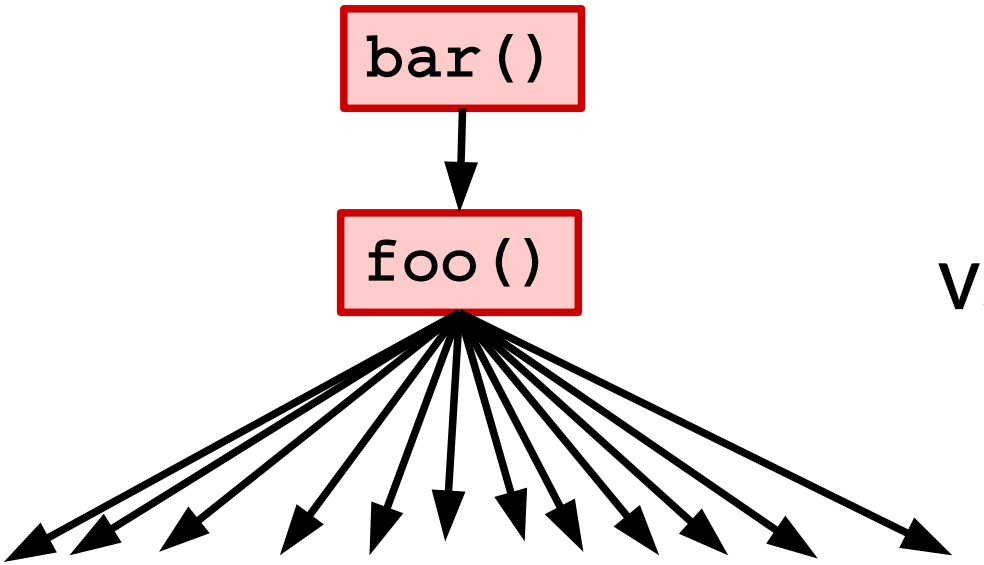
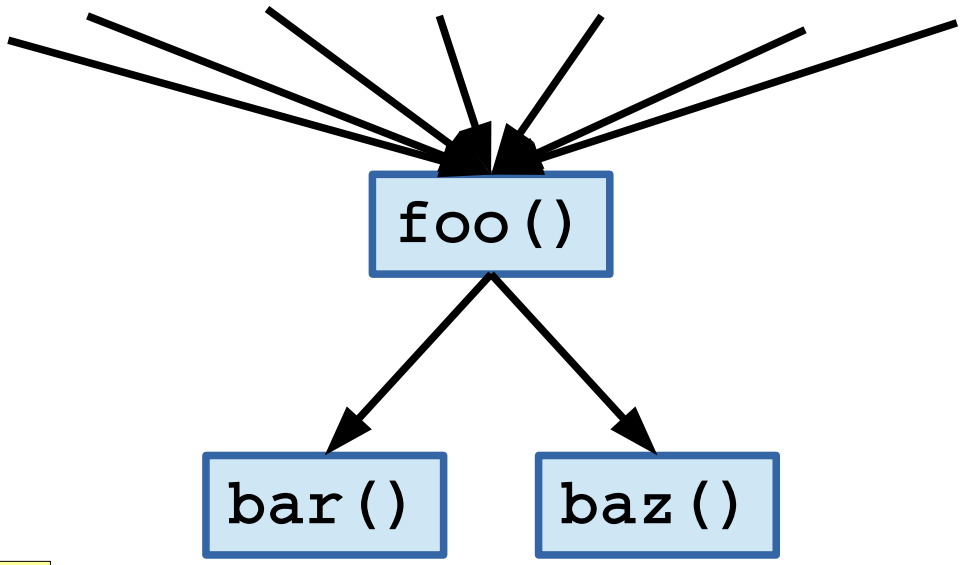


vs



Why?

What makes a design good?

- Not clever
- Loose coupling
- High fan in / low fan out
- Layers / Stratification

& a consistent, self contained view per level

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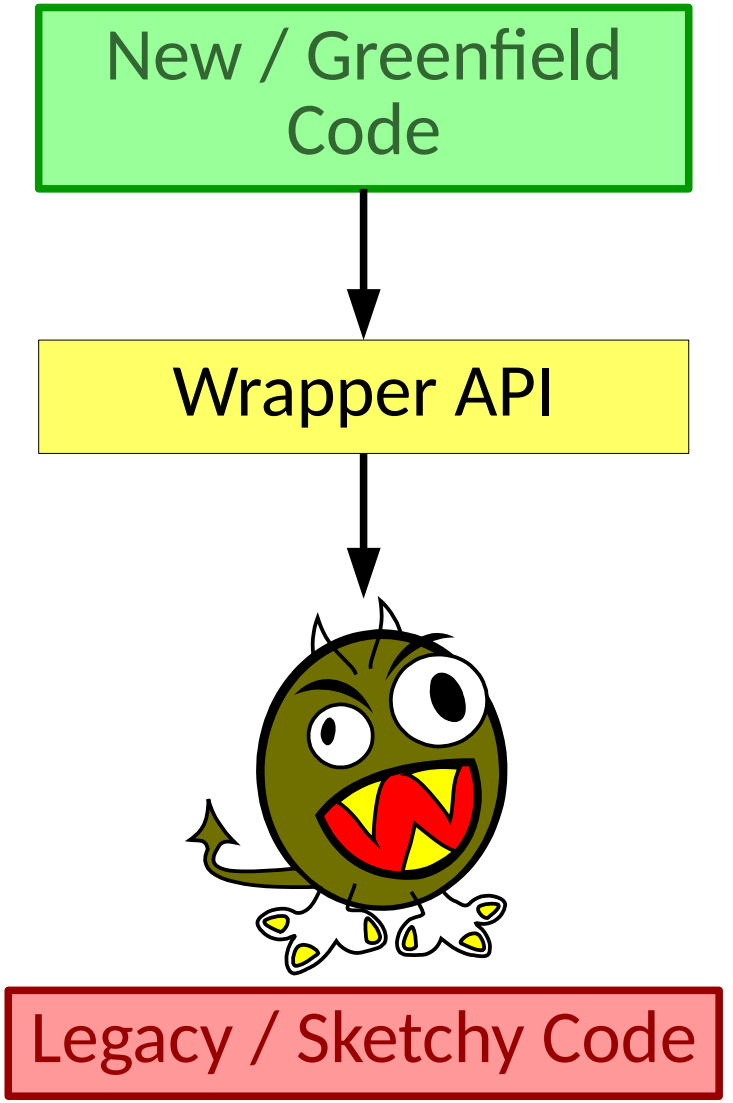

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- Cohesion
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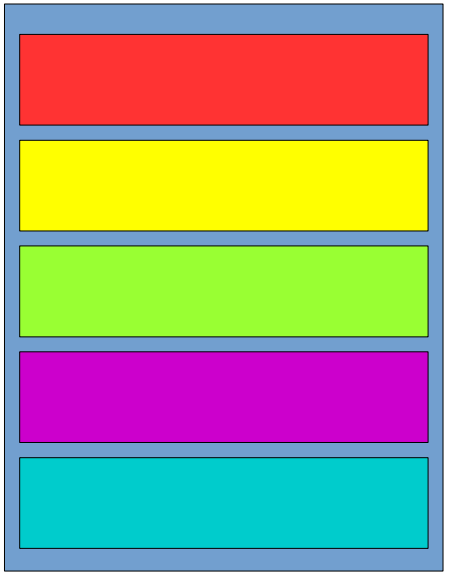

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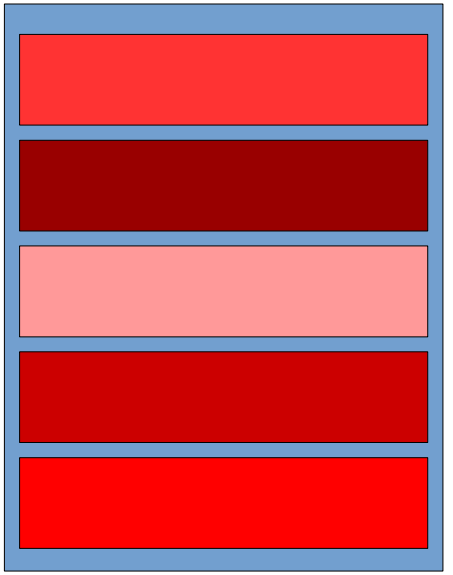

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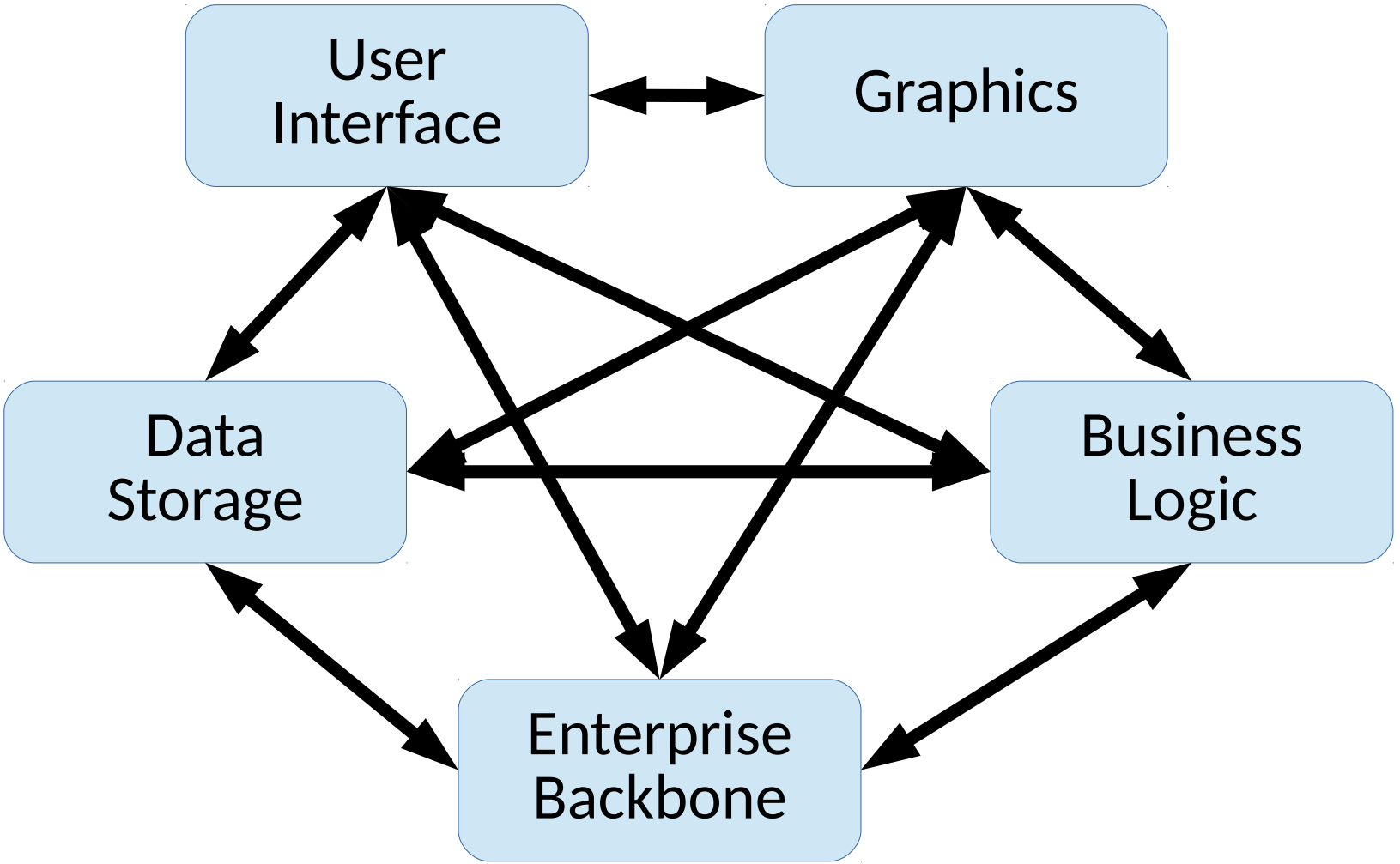
But these are the ends, not the means

Consider a design



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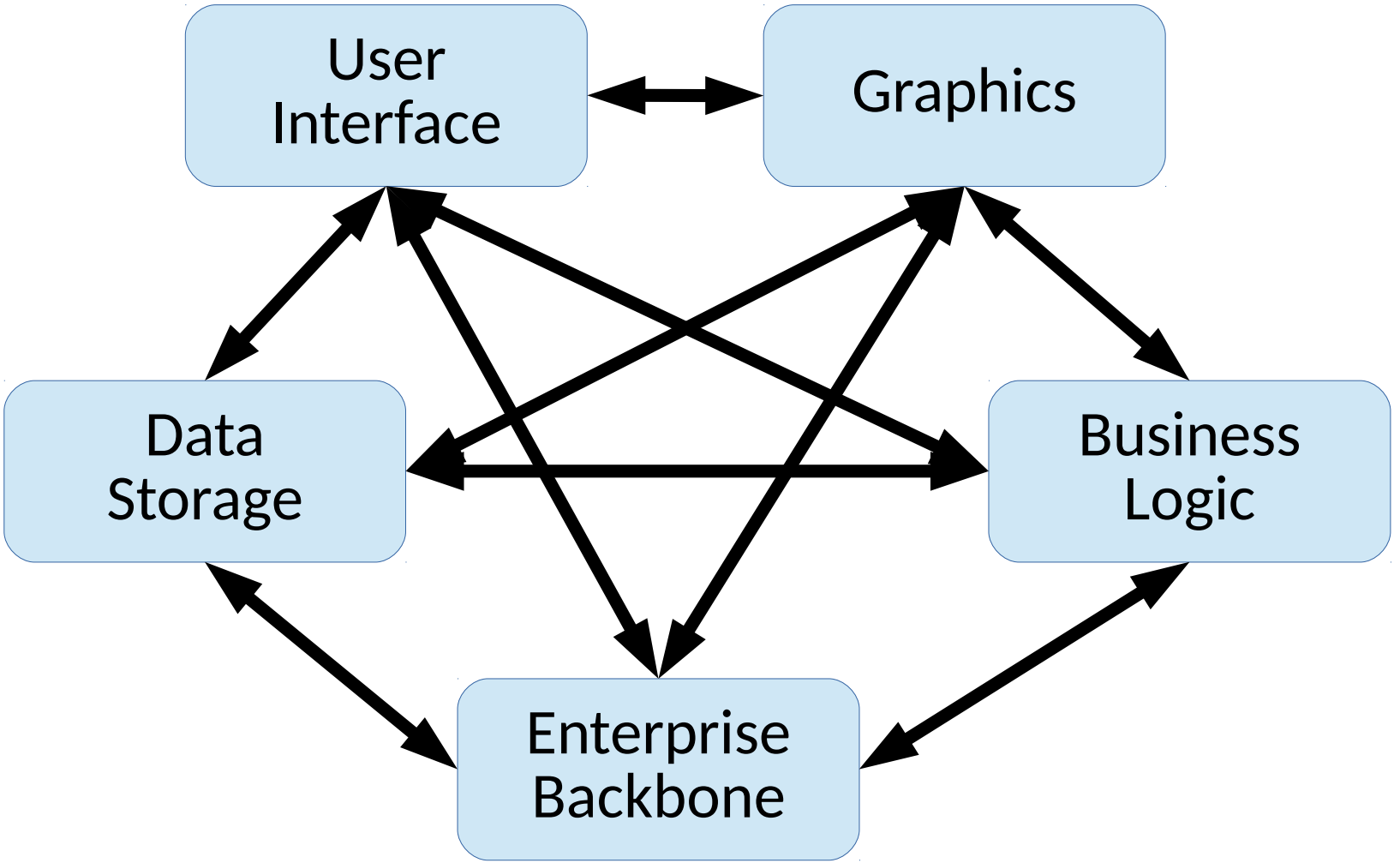
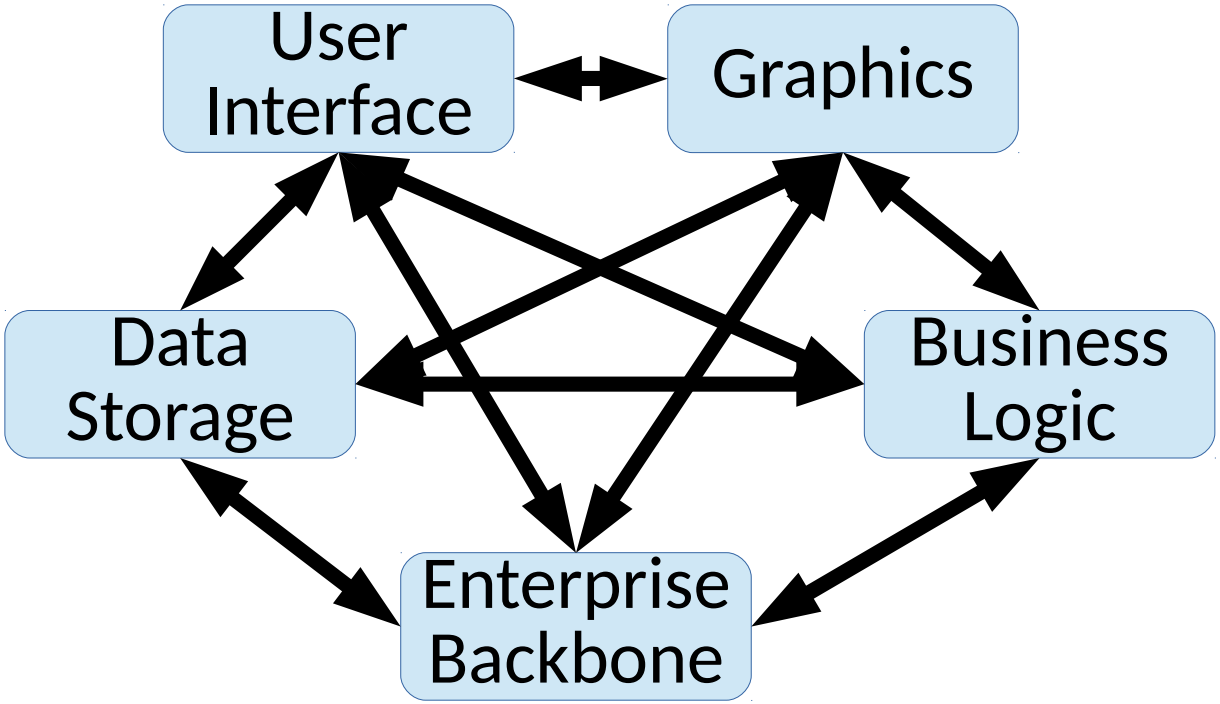


Is this simple? Why?

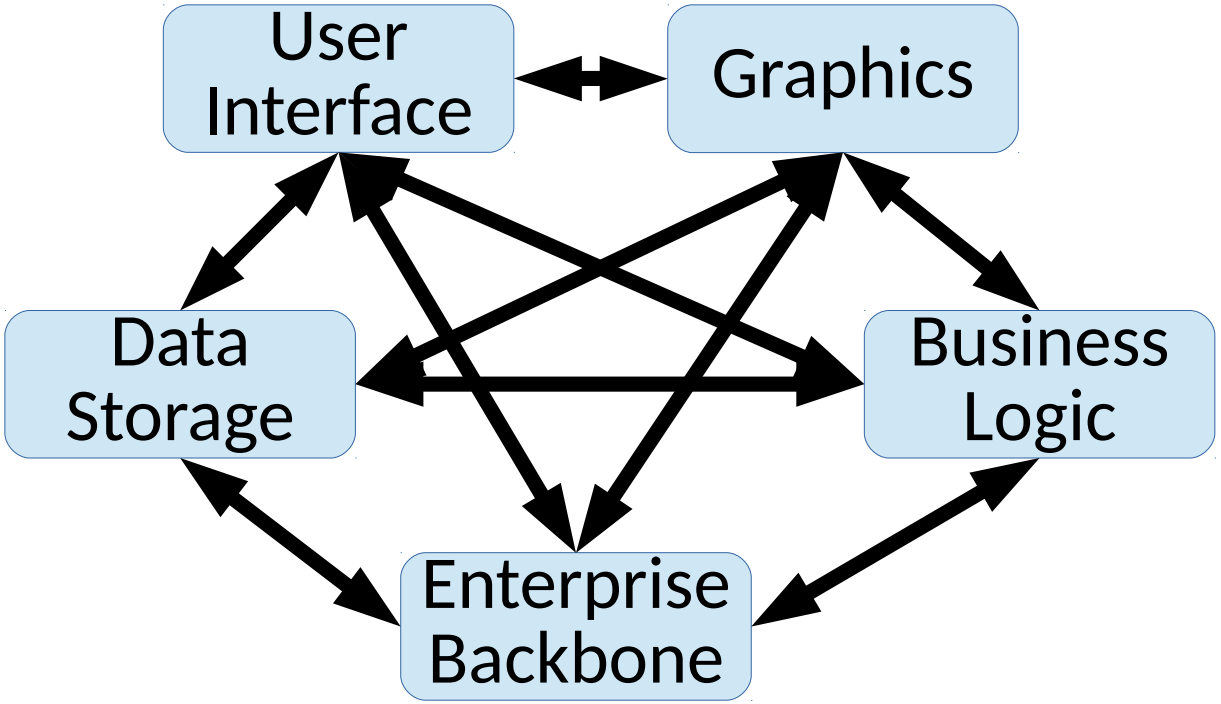
Consider a design

- What if you want to ***modify*** the business logic?



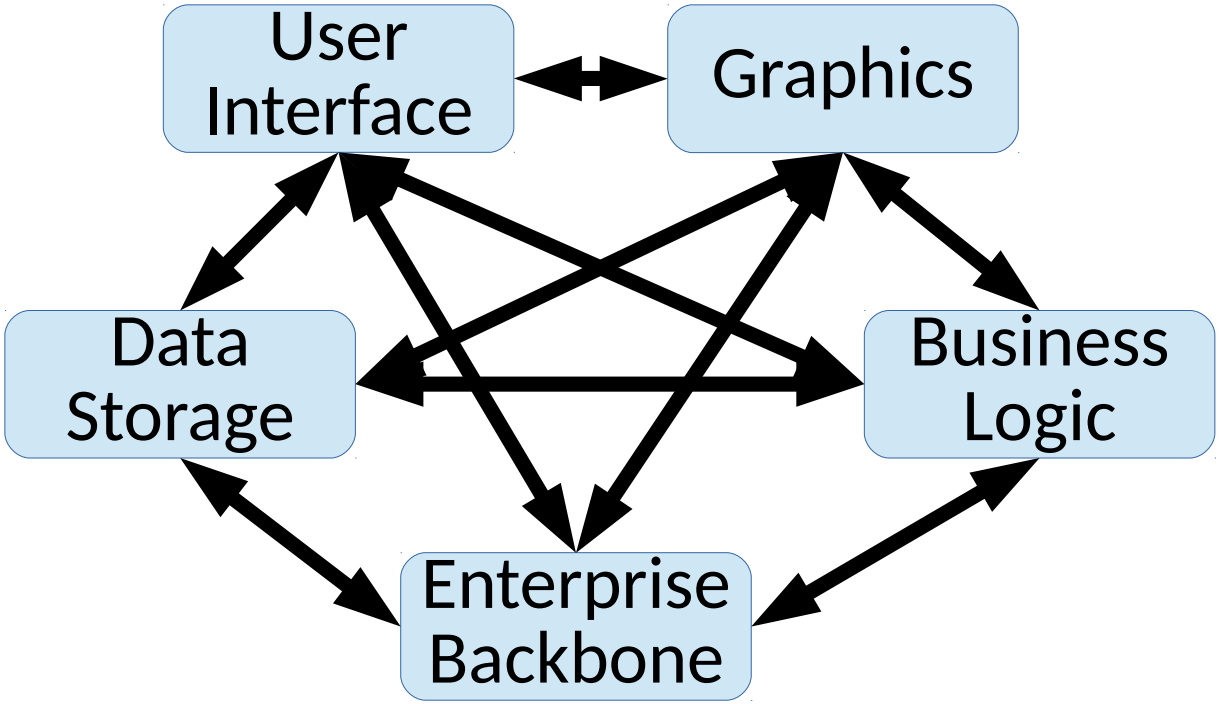
Consider a design

- What if you want to ***modify*** the business logic?
- What if you want to ***reuse*** the business logic?



Consider a design

- What if you want to ***modify*** the business logic?
- What if you want to ***reuse*** the business logic?
- What if you want to ***replace*** the display?



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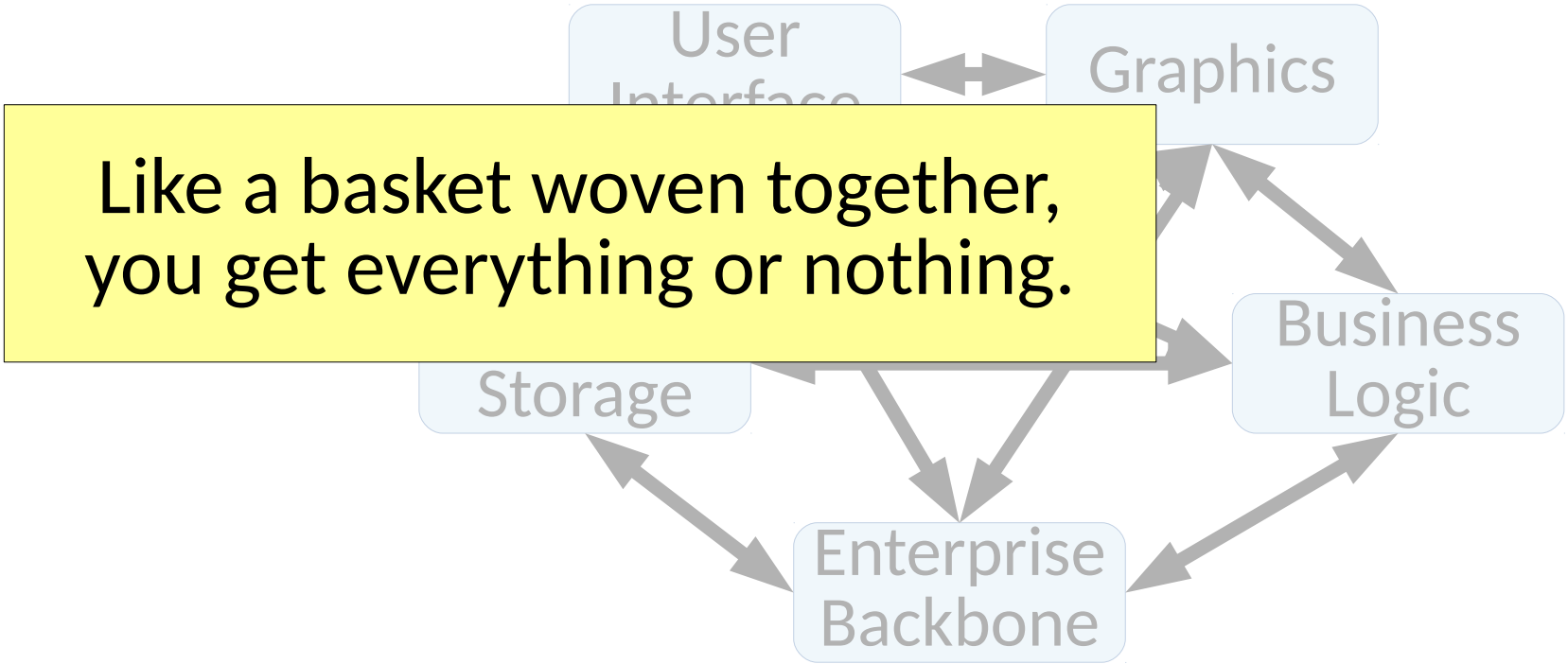

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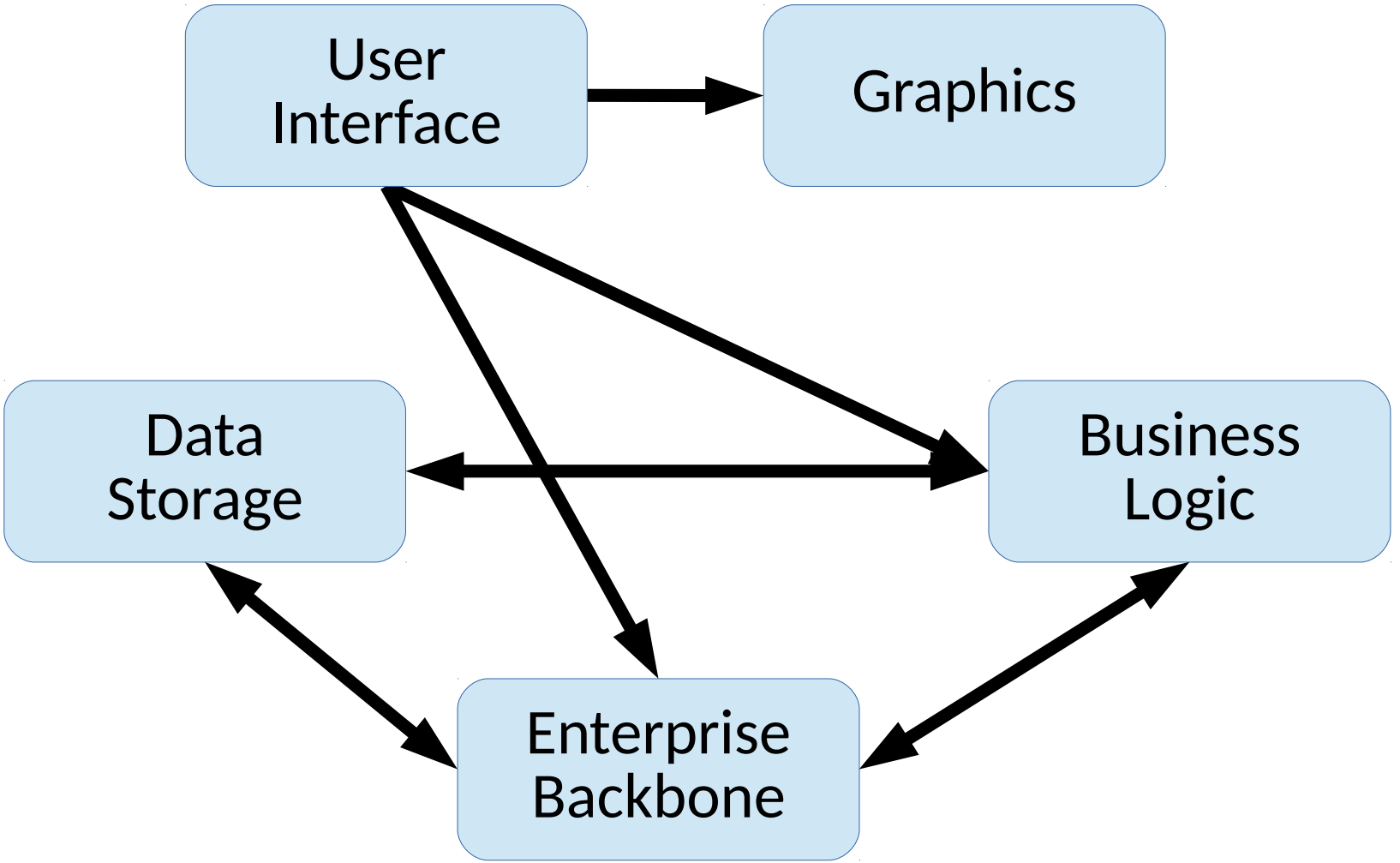

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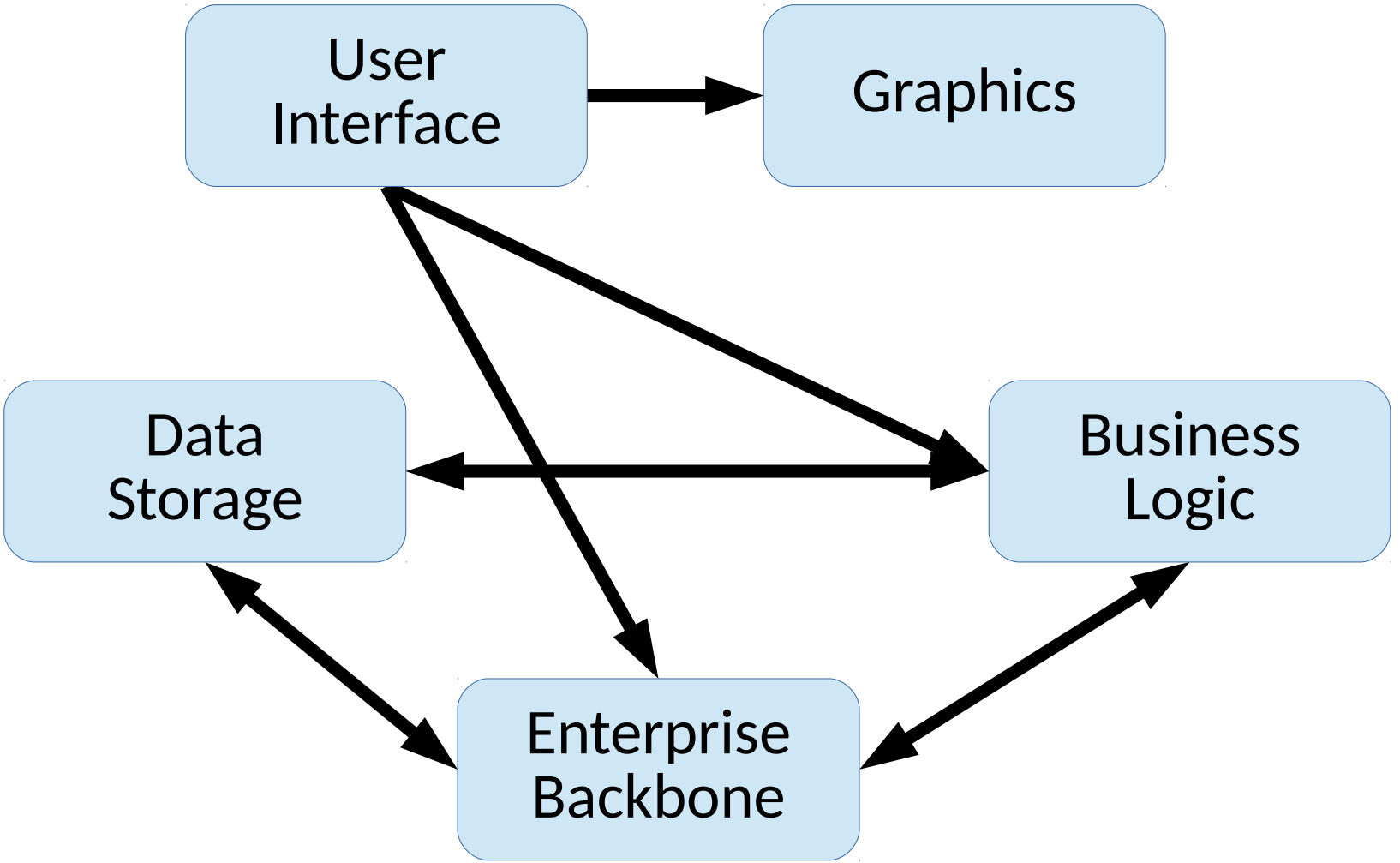

Is this simple***r***? Why?

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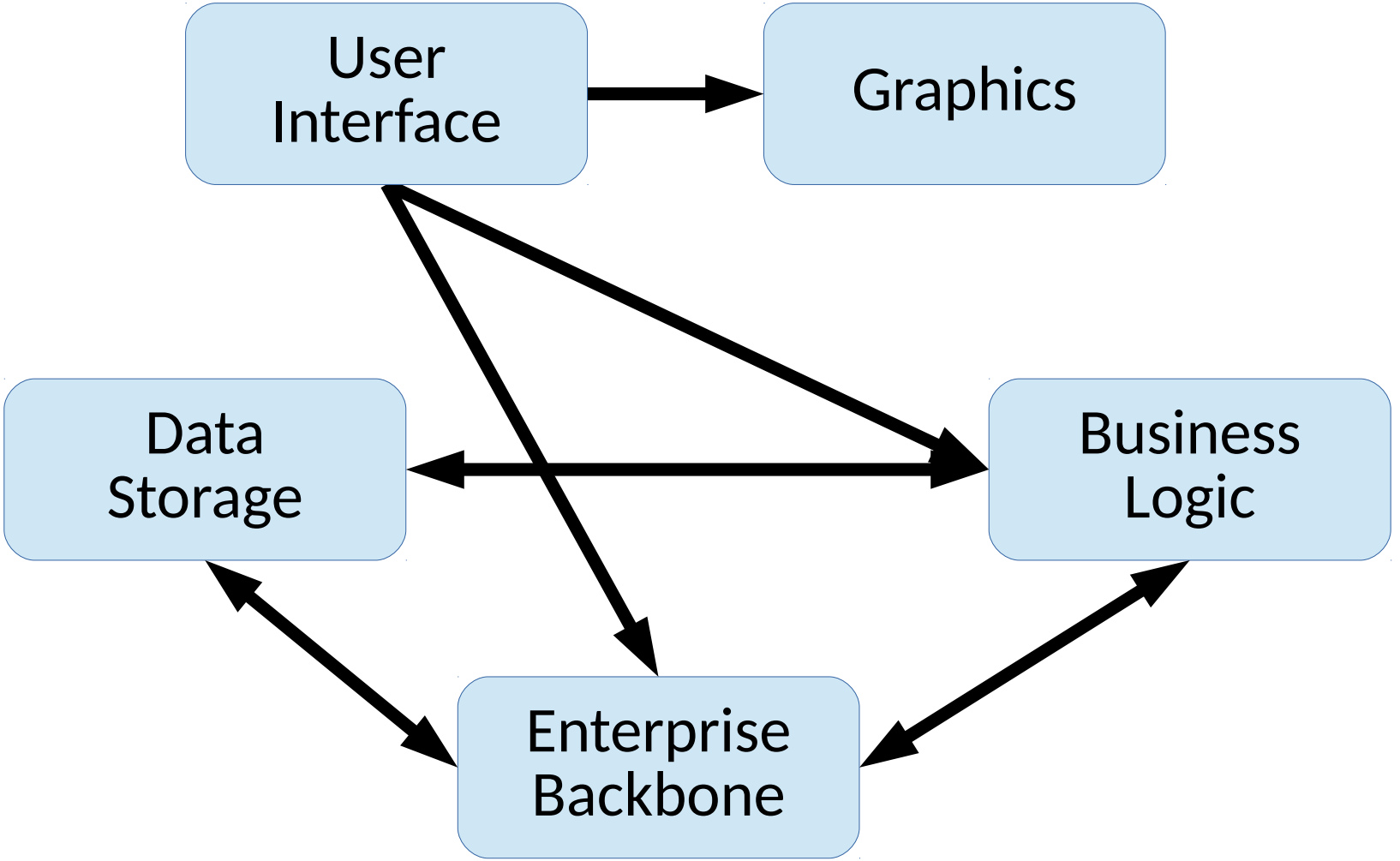

Is this simpler? Why?

What is still complex? Why?

Consider a design

- The fewer connected or conflated concepts, the better

Consider a function

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[redacted](double speed, double angle) {
   [redacted]
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Is this simple or complex? Why?

A good design should be ***hard to misuse***

Consider a class

```
class Student {
public:
  ...
  ID getID() const;
  Name getName() const;
  Address getAddress() const;

  void storeToDatabase() const;
  static Student readFromDatabase();

  bool canApplyForCoOp();
  bool meetsDegreeRequirements();
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What is *good* about this class?

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What is ***good*** about this class?

What is ***bad*** about this class?

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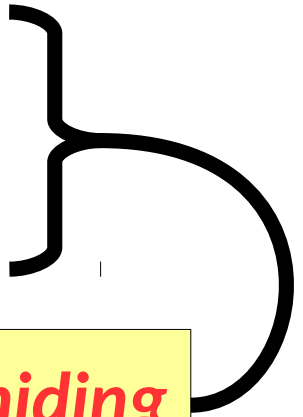

Deeply tied to ***information hiding***

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Use especially for:
1) likely/risky to change code
2) frequently used code

Key Strategy: Mitigate change

- Identify potential areas of change

```
class Student {
public:
   ...
   int getID() const;
   ...
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```
class IDCreator {
public:
   ...
   virtual ID createID() = 0;
   ...
};
```

Key Strategy: Mitigate change

```
...
ID studentID = student.getID();
...
```

How might this hinder change?

Key Strategy: Mitigate change

```
...
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How might this hinder change?

How can it be resolved?

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What are the trade offs?

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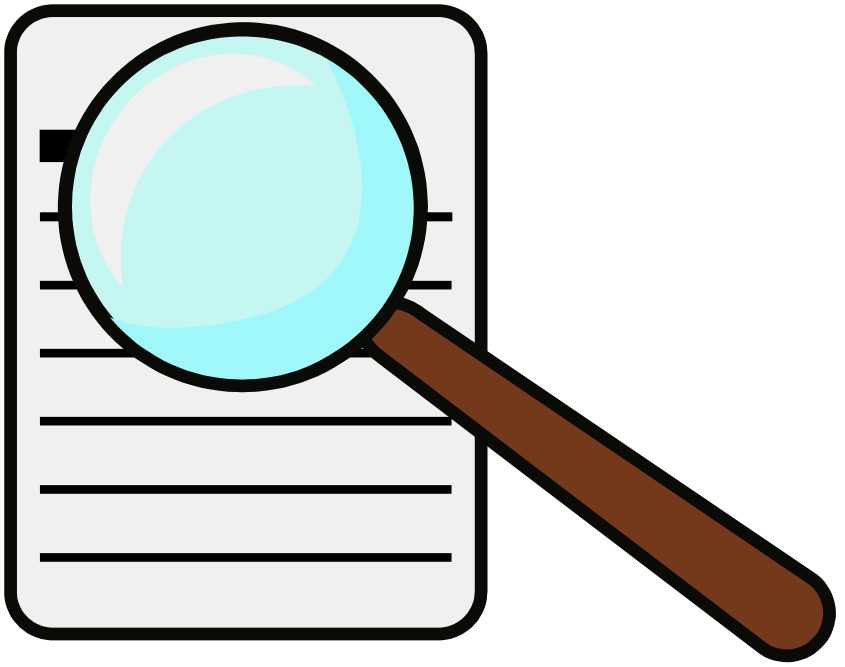
    [metaphors, abstraction, encapsulation, consistency, inheritance]



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    - You end up paying it back!

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  - Thin components
    - Is it really hiding an implementation?
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    - Can I see the implementation details? (unintentional interface)
    - Repeated similar code
  - Difficulty making a change

Experience

- Experience hones your sense of design.
  - Hopefully, our discussions this semester will help you be aware of it.