Interesting Ideas in Programming Languages

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2020-12-17

Introduction

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Looking at how different languages solve problems can inform you in your daily work (and it is fun).

Binary Pattern Matching

- switch
- destructuring
- (almost) everything

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```
sum(L) -> sum(L, 0)
sum([H | T], N) -> sum(T, N+H);
sum([], N) -> N.
```

Binary Pattern Matching

Task: Parse a DNS packet (RFC 1035 header).

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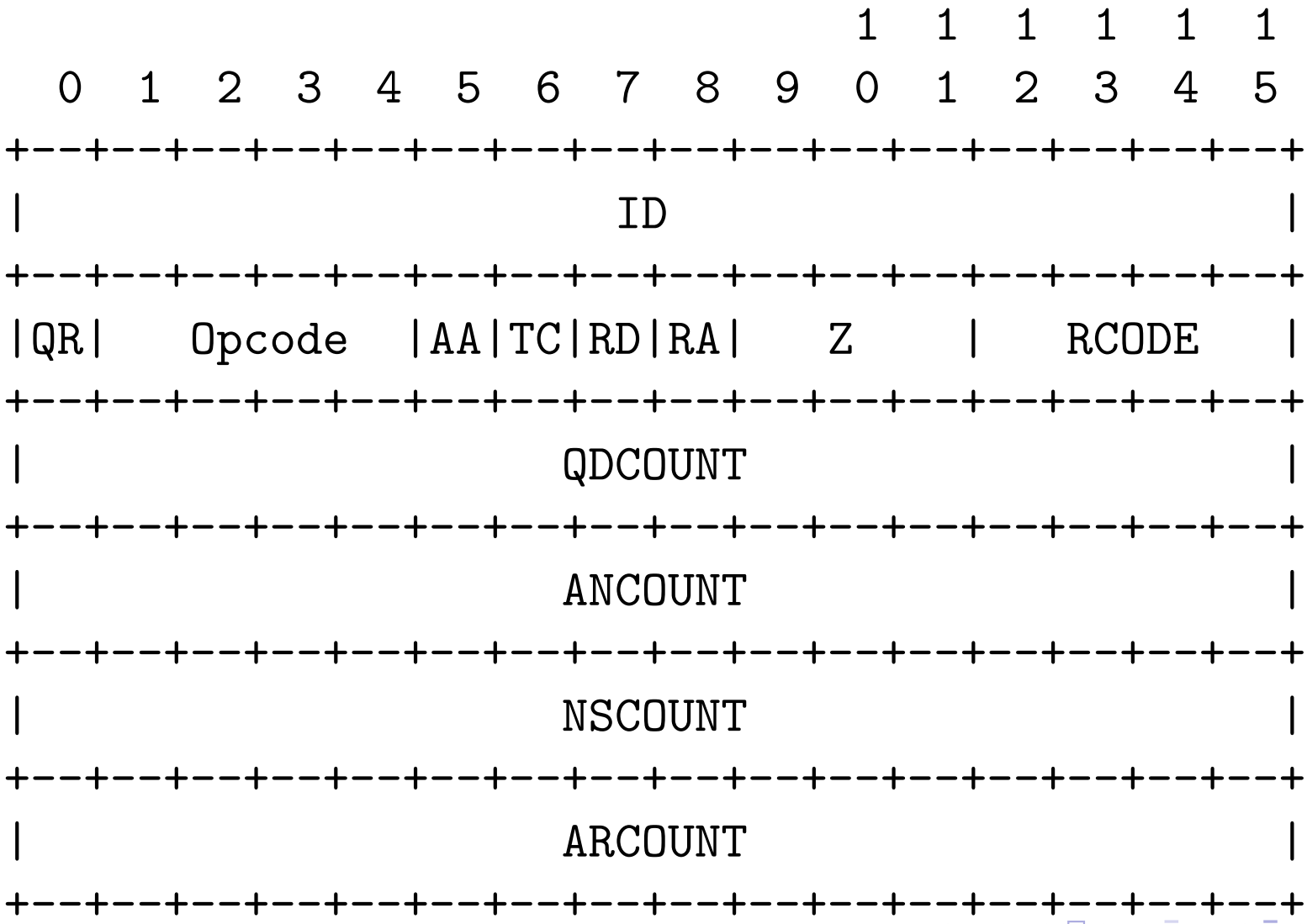

Binary Pattern Matching - C

Parse header in C

```
msg->id = isc_buffer_getuint16(source);
tmpflags = isc_buffer_getuint16(source);
msg->opcode = ((tmpflags & DNS_MESSAGE_OPCODE_MASK)
                        >> DNS_MESSAGE_OPCODE_SHIFT);
msg->rcode = (dns_rcode_t)(tmpflags & DNS_MESSAGE_RCODE_MASK);
msg->flags = (tmpflags & DNS_MESSAGE_FLAG_MASK);
msg->counts[DNS_SECTION_QUESTION] = isc_buffer_getuint16(source);
msg->counts[DNS_SECTION_ANSWER] = isc_buffer_getuint16(source);
msg->counts[DNS_SECTION_AUTHORITY] = isc_buffer_getuint16(source);
msg->counts[DNS_SECTION_ADDITIONAL] = isc_buffer_getuint16(source);
```

Binary Pattern Matching - Erlang

```
<<ID:16, QR:1, Opcode:4,
  AA:1, TC:1, RD:1, RA:1, Z:3, RCODE:4
  QDCOUNT:16, ANCOUNT:16, NSCOUNT:16,
  ARCOUNT:16, DNSBody/binary>> = DNSPacket,
  ...
```

Property based testing

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# the max value.
def max(ints) do
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```

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def max(ints) do
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test "find the max value" do
    assert max([0]) == 0
    assert max([1,1]) == 1
    assert max([1,2,3]) == 3
    assert max([3,2,1]) == 3
    assert max([-1, -100, -10000, ...]) == -1
    ...
end
```

Property based testing

```elixir
# Takes a nonempty list of integers and finds
# the max value.
def max(ints) do
    ...
end

property "find the max value" do
    forall x <- non_empty(list(integer())) do
       max(x) == List.last(Enum.sort(x))
    end
end
```

Propetry based testing

```
Failed: After 10 test(s).
[-1,6,3,1]
Shrinking ...(3 time(s))
[0,1]
...
```

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```
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[-1,6,3,1]
Shrinking ...(3 time(s))
[0,1]
...

OK: Passed 100 test(s).
===>
```

Propetry based testing

Positives

- Large amount of tests (after writing good properties more tests are "free").
- Tests change each run.
- Shrinks to find the smallest failing input.
- Higher confidence that your code if bug free.

Negatives

- Big effort to write properties. Often not trivial.
- Takes longer time to run.

Property based testing

Is it used anywhere?

Project FIFO 460 lines of property tests: Covered 60k lines of code. Found 25 "important" bugs.

LevelDB 600 lines of propetry tests. Found sequences of 17 and 31 specific calls that could corrupt the database.

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- Works better with powerful type systems.

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Type Driven Development

DEMO

End

There are interesting and useful things in the world of PLs, go explore!