

# Java binary serialization review

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# Requirements

We use serialization in 3 cases:

- 1 to store;
- 2 to transmit;
- 3 to loose;

Main features to consider:

- 1 serialize/deserialize speed;
- 2 serialized size;
- 3 stability to change;
- 4 laboriousness;
- 5 platform-dependence;

# JDK tools

- Standard serialization: smallest effort / worst performance;
- Externalizable serialization: full control over serialization, define your binary format, no features;

serialization	speed	size	stability to change	laboriousness	platform dependence
standard	poor	big	average	low	only java
externalizable	fast	small	poor	high	independent

Table : Standard serialization vs Externalizable

# Why use something else?

## Motivation:

- conveniently simple and fast approaches;
- better adopted for our data: optional params, variable-length numbers, aliases;
- independence from language necessary in some cases.

## Here we consider:

- protobuf - <https://code.google.com/p/protobuf/>;
- avro - <http://avro.apache.org/>;
- kryo - <https://github.com/EsotericSoftware/kryo>.

# Protobuf

## Protobuf info

- needs proto-file with description of your data in primitives;
- java, python, c++ officially supported;
- performant and compact;

### .proto file:

```
package tutorial;

option java_package = "com.example.tutorial";
option java_outer_classname = "AddressBookProtos";

message Person {
  required string name = 1;
  required int32 id = 2;
  optional string email = 3;

  enum PhoneType {
    MOBILE = 0;
    HOME = 1;
  }

  message PhoneNumber {
    required string number = 1;
    optional PhoneType type = 2 [default = HOME];
  }

  repeated PhoneNumber phone = 4;
}

message AddressBook {
  repeated Person person = 1;
}
```

# Avro

## Avro info

- needs schema-file, can use different schemes to read and write;
- java, python, C  
C++, Ruby;
- schema stored with data  $\Rightarrow$  compact files; no manual field-IDs;
- code-generational optional for static languages;

```
{  
  "type": "record",  
  "name": "Employee",  
  "fields": [  
    {"name": "name", "type": "string"},  
    {"name": "age", "type": "int"},  
    {"name": "emails", "type": {"type": "array", "items": "string"}},  
    {"name": "boss", "type": ["Employee", "null"]}  
  ]  
}
```

# Kryo

## Kryo info

- Used as standard serialization with custom serializer when you need it;
- Only java;
- For custom serializer there are primitives and features (variable-length numbers, positive optimisations);

Automatic serialization  $\Rightarrow$  not much difference from standard serialization:

```
Kryo kryo = new Kryo();

Output output = new Output(new FileOutputStream("file.bin"));
SomeClass someObject = ...
kryo.writeObject(output, someObject);
output.close();

Input input = new Input(new FileInputStream("file.bin"));
SomeClass someObject = kryo.readObject(input, SomeClass.class);
input.close();
```

# Kryo custom

To customize serializer, submit `Serializer` to Kryo object or read/write primitives using methods of `Input/Output`:

```
public class StoredUrl2Serializer extends Serializer<StoredUrl2> {

    @Override
    public void write(Kryo kryo, Output output, StoredUrl2 storedUrl2) {
        output.writeByte(0); // first version of format, placeholder for future versions and optimizations
        output.writeString(this.url.toString());
        output.writeShort(crawlResultCode);
        ...
        output.writeVarInt((int) lastFetchTime, false);
        Kryo.writeObjectOrNull(output, sourceIds, String.class);
        kryo.writeObjectOrNull(output, outLinks2, OutLink[].class);
        ...
        output.writeVarLong(contentLength, false);
    }

    @Override
    public StoredUrl2 read(Kryo kryo, Input input, Class<StoredUrl2> aClass) {
        byte format;
        if ((format = input.readByte()) != 0) {
            throw new RuntimeException("Format not supported: " + format);
        }
        Url url = new Url(input.readString(), false);
        crawlResultCode = input.readShort();
        ...
        long lastFetchTime = input.readVarInt(false);
        @Nullable String sourceIds = kryo.readObjectOrNull(input, String.class);
        @Nullable OutLink[] outLinks = kryo.readObjectOrNull(input, OutLink[].class);
        long contentLength = input.readVarLong(false);
        ...
        return new StoredUrl2(url, ..., contentLength);
    }
}
```



# Standard vs Kryo

Tested on core i5-2450M + SSD

Without compression:

parameter	standard	kryo	change %
read time, msec (1.5m objects)	4999	2395	52% faster
write time, msec (500k objects)	2283	975	67% faster
object size (bytes)	332	264	20% more compact

Table : Standard vs Kryo in planners queue

With snappy:

parameter	standard	kryo	change %
read time, msec (1.5m objects)	5306	2626	51% faster
write time, msec (500k objects)	3406	1250	63% faster
object size (bytes)	110	91	18% more compact

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- Let's compress more:  
GZip compress well, but too slow. Deflate with *BEST\_SPEED* option perform between GZip and Snappy.

```
public KryoStoredUrlWriter create(@NotNull File file)
    throws IOException {

    Deflater def = new Deflater(Deflater.BEST_SPEED);

    return new KryoStoredUrlWriter(
        new DeflaterOutputStream(
            new BufferedOutputStream(new FileOutputStream(file), 4 * 1024),
            def
        )
    );
}
```

# Standard vs. Kryo in queue

parameter	standard + snappy	kryo + deflate	change %
read time, msec (1.5m objects)	5292	4150	22% faster
write time, msec (500k objects)	2529	2461	same
object size (bytes)	110	73	33% more compact
reconstruction time planner2v (min)	240	210	12.5% faster

Table : Standard + snappy vs Kryo + deflate

Space economy on planner2v (5 storages + 3 queue backups): 250Gb

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