Fish and Chips and Apache Kafka®

By Tibs (they / he)

Slides and accompanying material at
https://github.com/tibs/fish-and-chips-and-kafka-talk

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What we'll cover

- Me and messaging and Apache Kafka®
- Fish and chips
    - How to talk to Kafka
    - Start with a simple model and work up
    - There's a demo you can play with afterwards
    - Some ideas for things you can do to extend the demos

Some message problems I've cared about

- between components on a Set Top Box
- configuration between microservices
- to / from Internet of Things devices, and their support systems

Kafka is a very good fit for the IoT cases, maybe less so for the others

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What I want from messaging

- multiple producers *and* multiple consumers
- single delivery
- guaranteed delivery
- resumes safely if system crashes
- no back pressure handling (queue does not fill up)

Enter, Apache Kafka®

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Kafka terms

Messages are *Events*

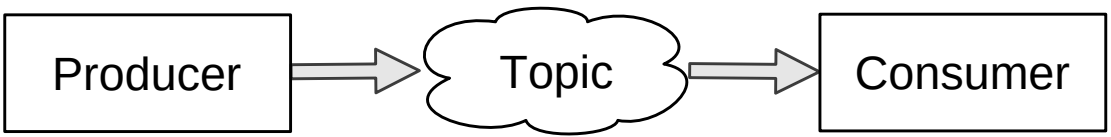
Producers send messages, *Consumers* read them.

Can have multiple Producers and Consumers

A Producer send a message to a named *Topic*, each Consumer reads from a single Topic

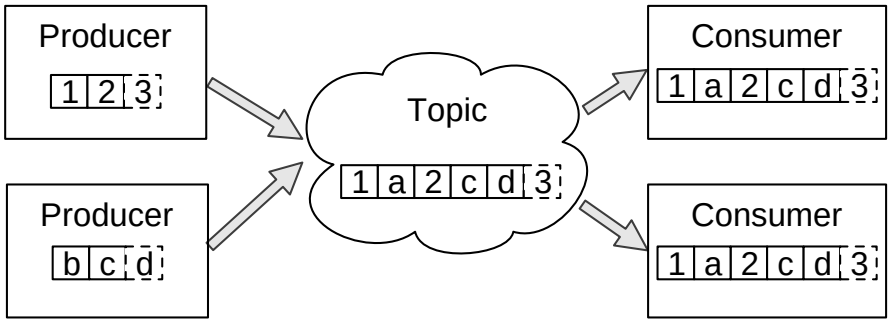
Partitions can be used to "spread the load" within a Topic

Producers, topics, consumers



Events

Multiple produces, multiple consumers



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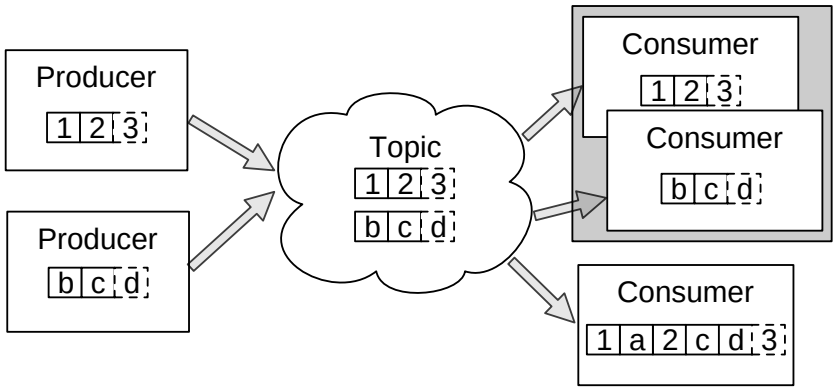
Multiple partitions, consumer groups



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Let's model a fish-and-chip shop

We start with a shop that

- just handles cod and chips
- which are always ready to be served

Glossary

- **Cod**: the traditional white fish for english fish-and-chip shops
- **Chips**: fatter, possibly soggier, french fries
- **Plaice**: a flat fish
- **Till**: a cash register

Serving a customer

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An order

```
{
   "order": 271,
   "parts": [
       ["cod", "chips"],
       ["chips", "chips"],
   ]
}
```

Show first demo

1 till, 1 food preparer

Libraries

`kafka-python`: https://github.com/dpkp/kafka-python

`aiokafka`: https://github.com/aio-libs/aiokafka

and

`Textual`: https://github.com/Textualize/textual

`Rich`: https://github.com/Textualize/rich

Code: Producer

```
from kafka import KafkaProducer

producer = kafka.KafkaProducer(
    bootstrap_servers=f"{HOST}:{SSL_PORT}",
    security_protocol="SSL",
    ssl_cafile=f'{certs_dir}/ca.pem',
    ssl_certfile=f'{certs_dir}/service.cert',
    ssl_keyfile=f'{certs_dir}/service.key',
    value_serializer=lambda v: json.dumps(v).encode('ascii'),

while SHOP_IS_OPEN:
    producer.send('ORDER'), order)
```

Code: Consumer

```
from kafka import KafkaConsumer

consumer = KafkaConsumer(
    "ORDER",
    bootstrap_servers=f"{HOST}:{SSL_PORT}",
    security_protocol="SSL",
    ssl_cafile="ca.pem",
    ssl_certfile="service.cert",
    ssl_keyfile="service.key",
    value_deserializer = lambda v: json.loads(v.decode('ascii')),
)

for msg in consumer:
    print(f'Message {msg.value}')
```

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Code: Asynchronous - needs SSL context

```
import aiokafka.helpers

context = aiokafka.helpers.create_ssl_context(
    cafile=CERTS_DIR / "ca.pem",
    certfile=CERTS_DIR / "service.cert",
    keyfile=CERTS_DIR / "service.key",
)
```

Code: Asynchronous Producer

```
from aiokafka import AIOKafkaProducer

producer = aiokafka.AIOKafkaProducer(
    bootstrap_servers=f"{HOST}:{SSL_PORT}",
    security_protocol="SSL",
    ssl_context=context,
    value_serializer=lambda v: json.dumps(v).encode('ascii'),
)

await producer.start()

while SHOP_IS_OPEN:
    await producer.send('ORDERS', message)
```

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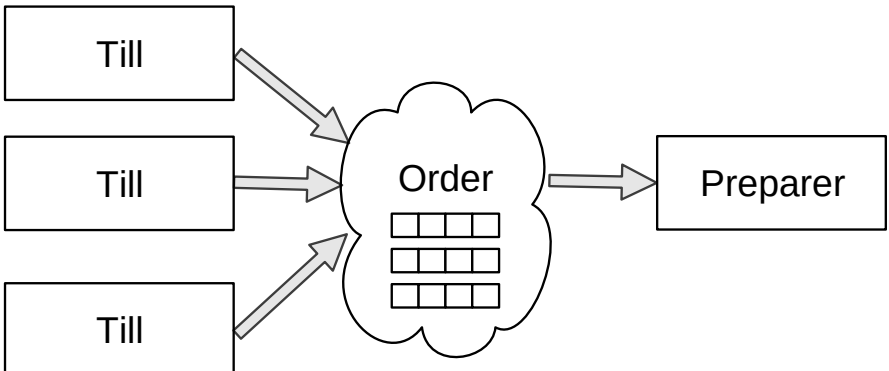
Code: Asynchronous Consumer

```
consumer = aiokafka.AIOKafkaConsumer(
    'ORDERS',
    bootstrap_servers=f"{HOST}:{SSL_PORT}",
    security_protocol="SSL",
    ssl_context=context,
    value_deserializer = lambda v: json.loads(v.decode('ascii')),
)

await consumer.start()

async for message in consumer:
    print(f'Received {message.value}')
```

More customers - add more TILLs

Customers now queue at multiple TILLs, each TILL is a Producer.

Three tills



An order with multiple TILLs

```
{
   "order": 271,
   "till": 3,
   "parts": [
       ["cod", "chips"],
       ["chips", "chips"],
   ]
}
```

How we alter the code

When creating the topic for the demo, request 3 partitions:

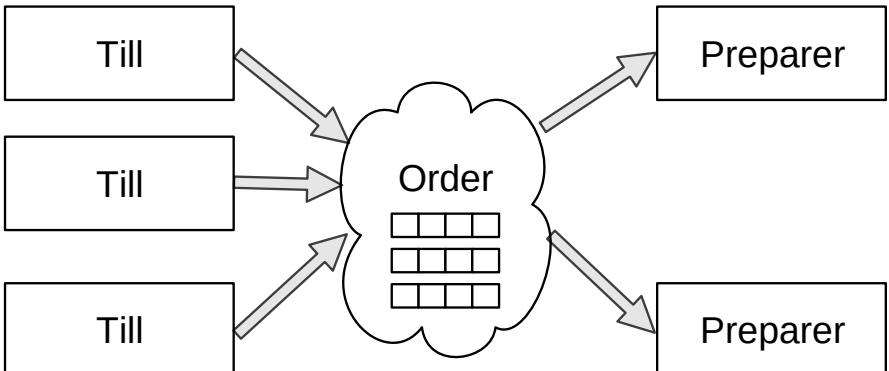
```
NewTopic(
    name='DEMO2-ORDERS',
    num_partitions=3,
    replication_factor=1,
)
```

Create 3 Till producers instead of 1

Show demo: multiple TILLs

Three tills, 3 partitions, 1 food preparer

Add multiple *consumers*



How we alter the code

Create 2 Food preparer consumers instead of 1

Consumers need to be in same *consumer group*

```
consumer = aiokafka.AIOKafkaConsumer(
    ...
    group_id=CONSUMER_GROUP,
    ...
```

Start consuming from a specific offset

If I run a demo more than once, there's a chance that a consumer might receive events from the previous demo. So we want to make sure that doesn't happen.

Various solutions - simplest for this case is to do:

```
await consumer.seek_to_end()
```

Sending to different partitions

```
await producer.send(TOPIC_NAME, value=order)
```

```
await producer.send(TOPIC_NAME, value=order, key='till')
```

```
await producer.send(TOPIC_NAME, value=order, partition=till_number-1)
```

Show demo: multiple TILLs and PREPARERS

Three tills, 3 partitions, 2 food preparers

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Cod or plaice

Plaice needs to be cooked

So we need a COOK to cook it

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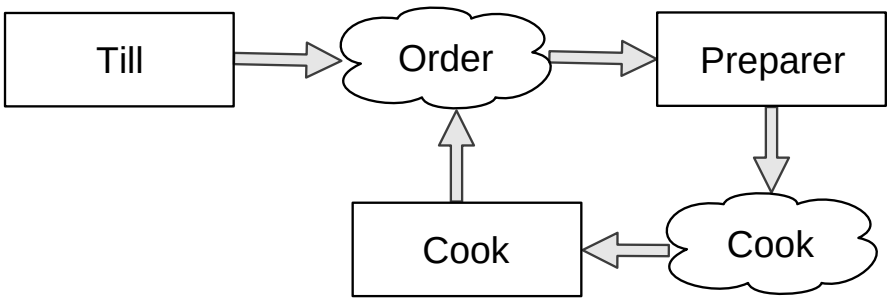
Participant changes - add COOK



An order with plaice

```
{
   "order": 271,
   "till": 3,
   "parts": [
       ["cod", "chips"],
       ["chips", "chips"],
       ["plaice", "chips"],
   ]
}
```

Gets turned into...

```
{
   "order": 271,
   "till": 3,
   "parts": [
       ["cod", "chips"],
       ["chips", "chips"],
       ["plaice", "chips"],
   ],
   "ready": <boolean>
}
```

Code changes to the PREPARER

```
def all_order_available(self, order):
    if 'ready' not in order:
        all_items = itertools.chain(*order['order'])
        order['ready'] = 'plaice' not in all_items
    return order['ready']
```

```
order_available = self.all_order_available(order)
if not order_available:
    await self.producer.send(TOPIC_NAME_COOK, order)
```

In the new COOK

```
async for message in consumer:
    ...
    # "Cook" the (plaice in the) order
    await asyncio.sleep(random.uniform(COOK_FREQ_MIN, COOK_FREQ_MAX))
    # It's important to remember to mark the order as ready now!
    # (forgetting to do that means the order will keep going round the loop)
    order['ready'] = True
    await self.producer.send(TOPIC_NAME_ORDERS, order)
```

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Demo with COOK

1 till, 1 food preparer, 1 COOK

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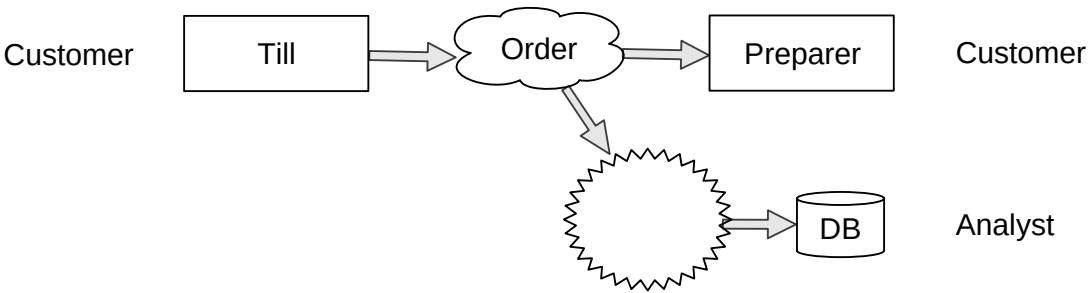
Summary so far

We know how to model the ordering and serving of our cod and chips

We know how to scale with multiple Producers and Consumers

We made a simple model for orders with plaice

Homework 1: Adding an ANALYST



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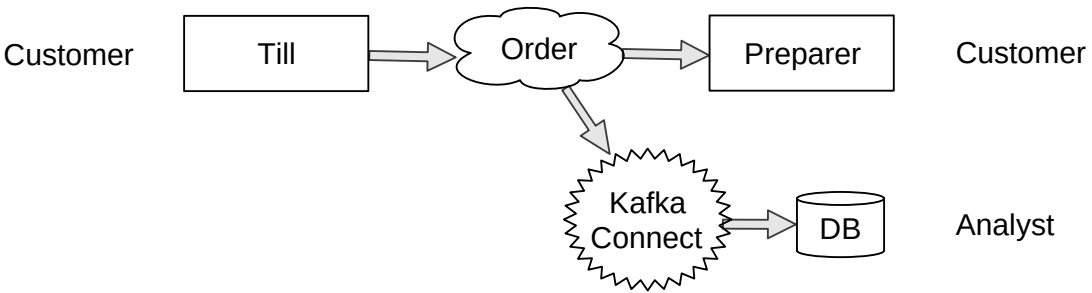
Using Kafka Connect



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Apache Kafka Connectors

These make it easier to connect Kafka to databases, OpenSearch, etc., without needing to write Python (or whatever) code.

How I would do it

The Aiven developer documentation has instructions on how to do this at https://docs.aiven.io/docs/products/kafka/kafka-connect/howto/jdbc-sink.html

- Create an appropriate PostgreSQL database and table
- Make sure that the Kafka service has Kafka Connect enabled
- Use the Aiven web console to setup a JDBC sink connector to send events to PG

And then add code to the Python demo to query PostgreSQL and make some sort of report over time.

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Homework 2: Model cooking the fish and chips

Use a Redis cache to simulate contents of the hot cabinet

Redis has entries for the hot cabinet content, keyed by `cod`, (portions of) `chips` and `plaice`. We start with 0 for all of them.

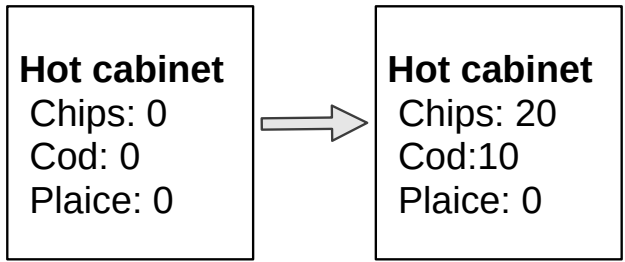
Using the cache

PREPARER compares the order to the counts in the cache. If there's enough "stuff" to make the order up, decrements the cache appropriately, and that's done

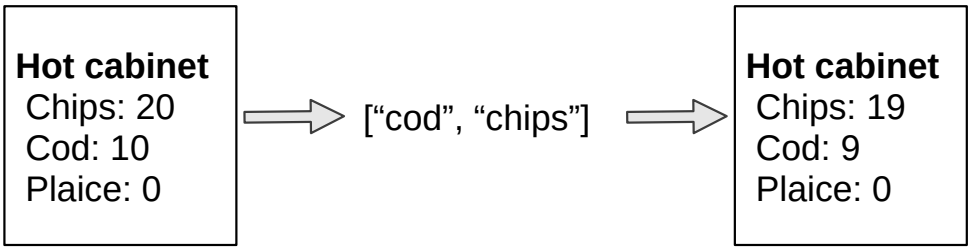
If not, sends the order to the COOK

COOK updates the cache - for `plaice`, adds as many as are needed, for the others, if they go below a threshold, adds a standard quantity back in ("cooking in batches"). Then sends the order back to the [ORDER] topic

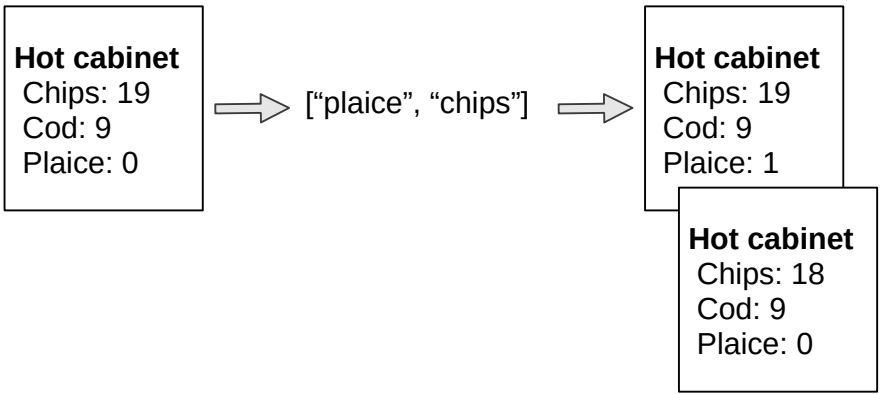
Start of day


Hot cabinet
Chips: 0
Cod: 0
Plaice: 0
Hot cabinet
Chips: 20
Cod:10
Plaice: 0

Cod and chips



Plaice and chips



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Final summary

We know how to model the ordering and serving of our cod and chips

We know how to scale with multiple Producers and Consumers

We made a simple model for orders with plaice

We talked briefly about using Kafka Connectors to share data with other data users

We talked briefly about how one might model the hot cabinet in more detail

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Acknowledgements

Fin

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