

Examining the Ignite Data Grid



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Overview



Durable memory

Native persistence

Caches

Configuration

JCache API



{ Key, Value }



Key	Value
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Key ₁	Value ₁
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Key ₁	Value ₁
Key ₂	Value ₂
Key ₃	Value ₃
Key ₄	Value ₄

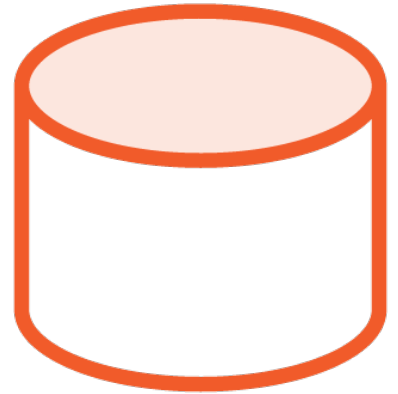
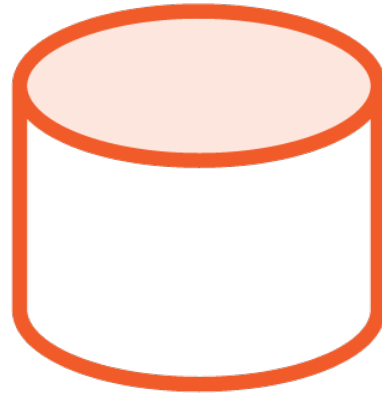
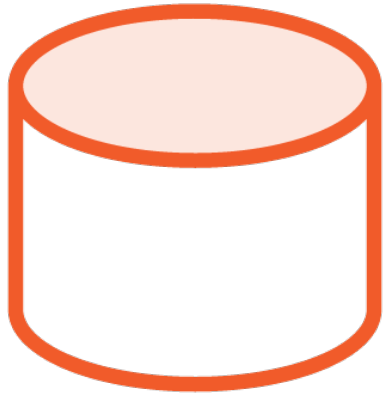
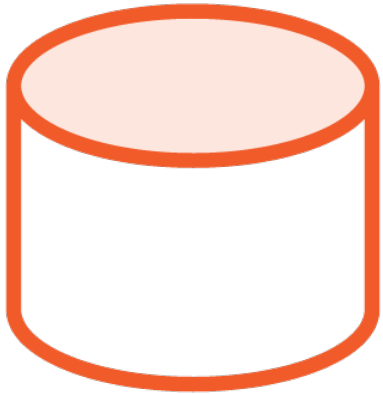


Key ₁	Value ₁
Key ₂	Value ₂
Key ₃	Value ₃
Key ₄	Value ₄

Key ₁	Value ₁
Key ₂	Value ₂
Key ₃	Value ₃
Key ₄	Value ₄

Key ₁	Value ₁
Key ₂	Value ₂
Key ₃	Value ₃
Key ₄	Value ₄

Key ₁	Value ₁
Key ₂	Value ₂
Key ₃	Value ₃
Key ₄	Value ₄

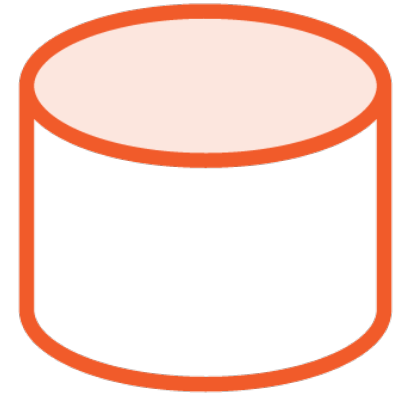
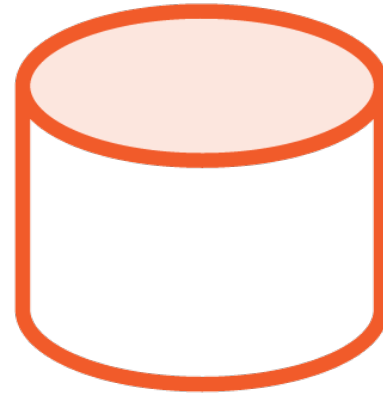
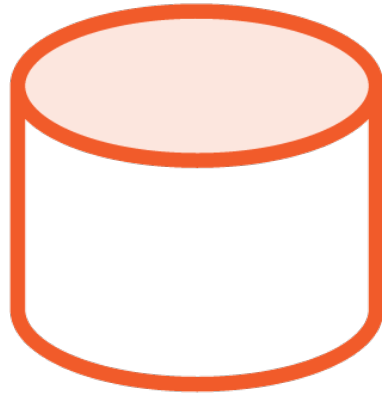
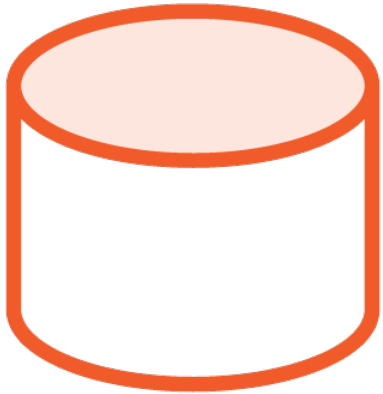


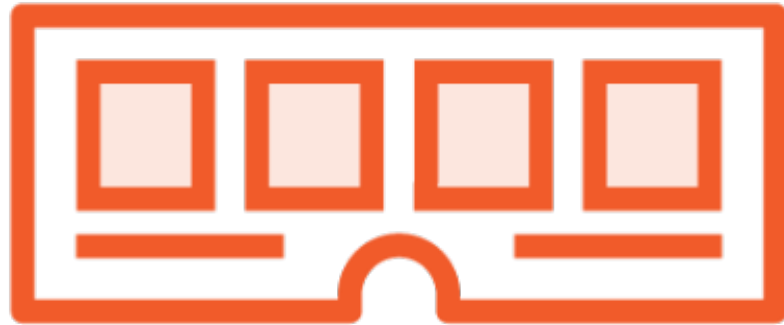
Key ₁	Value ₁
Key ₂	Value ₂
Key ₃	Value ₃
Key ₄	Value ₄

Key ₁	Value ₁
Key ₂	Value ₂
Key ₃	Value ₃
Key ₄	Value ₄

Key ₁	Value ₁
Key ₂	Value ₂
Key ₃	Value ₃
Key ₄	Value ₄

Key ₁	Value ₁
Key ₂	Value ₂
Key ₃	Value ₃
Key ₄	Value ₄





Total RAM: 100 GB



$$\sum_{i=1}^n$$



Total RAM: 200 GB





Total RAM: 100 GB





Total RAM: 100 GB





Total RAM: 3 TB



Apache Ignite Stack

Streaming

Service Grid

Management &
Monitoring

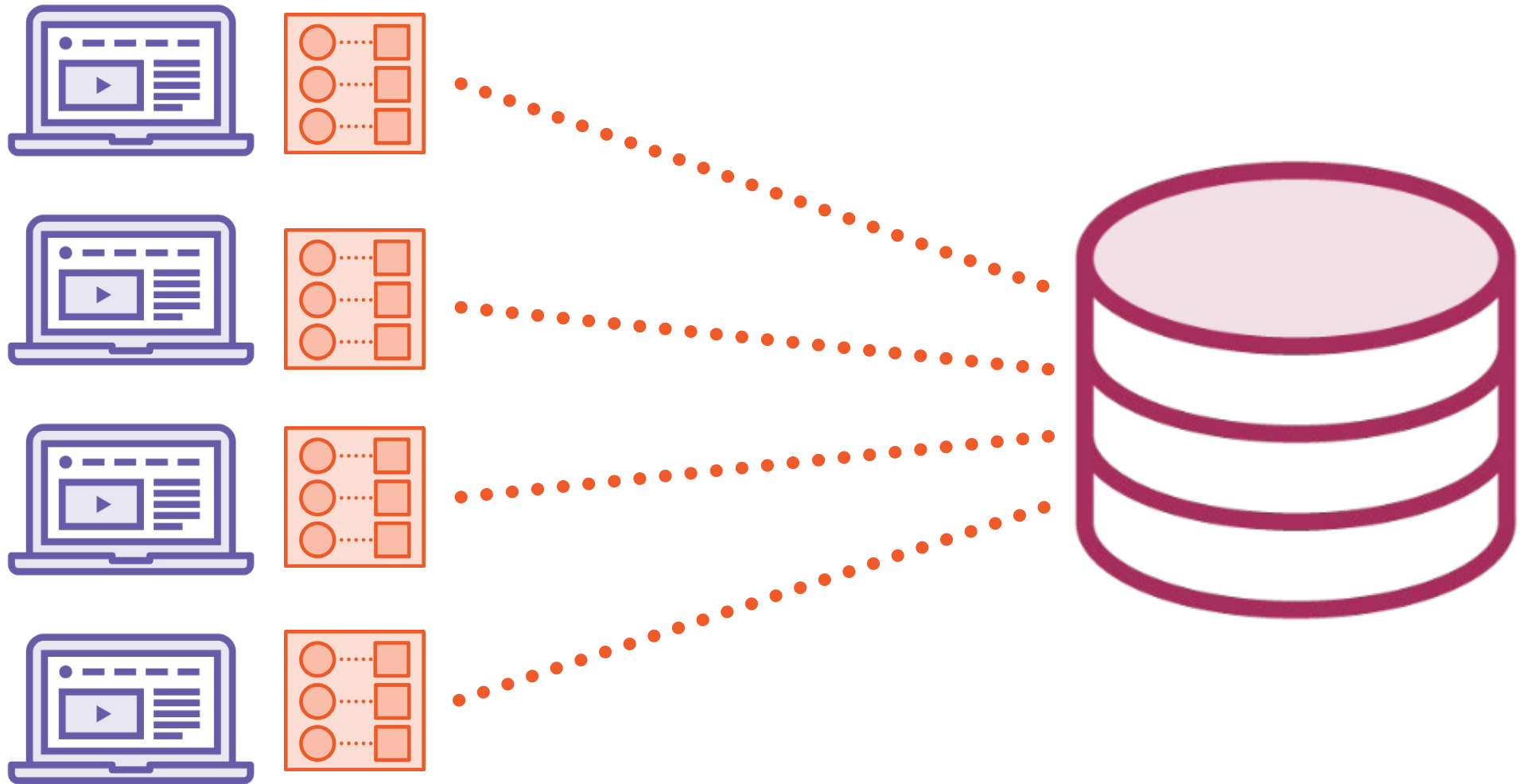
SQL

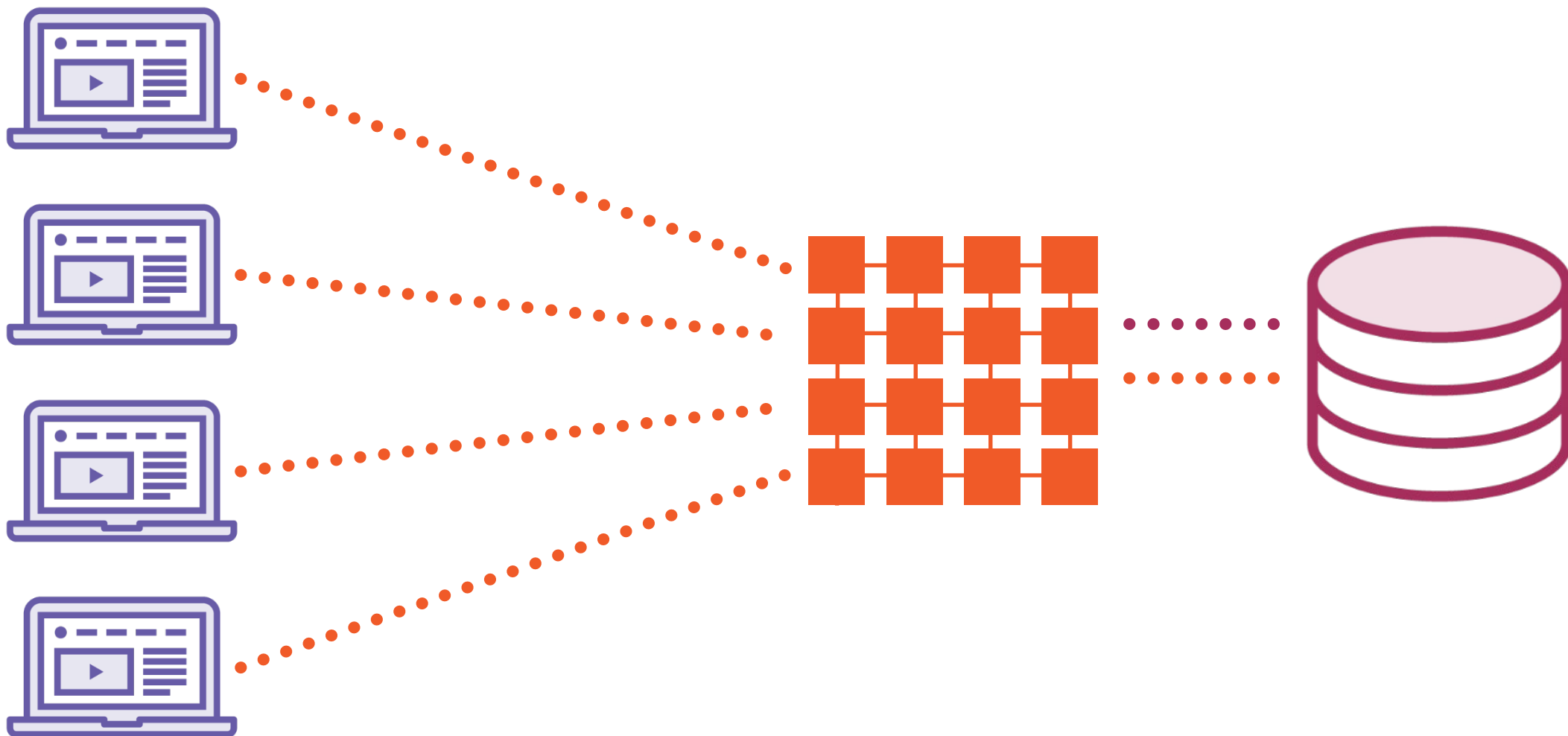
Data Grid

Compute Grid

Clustering

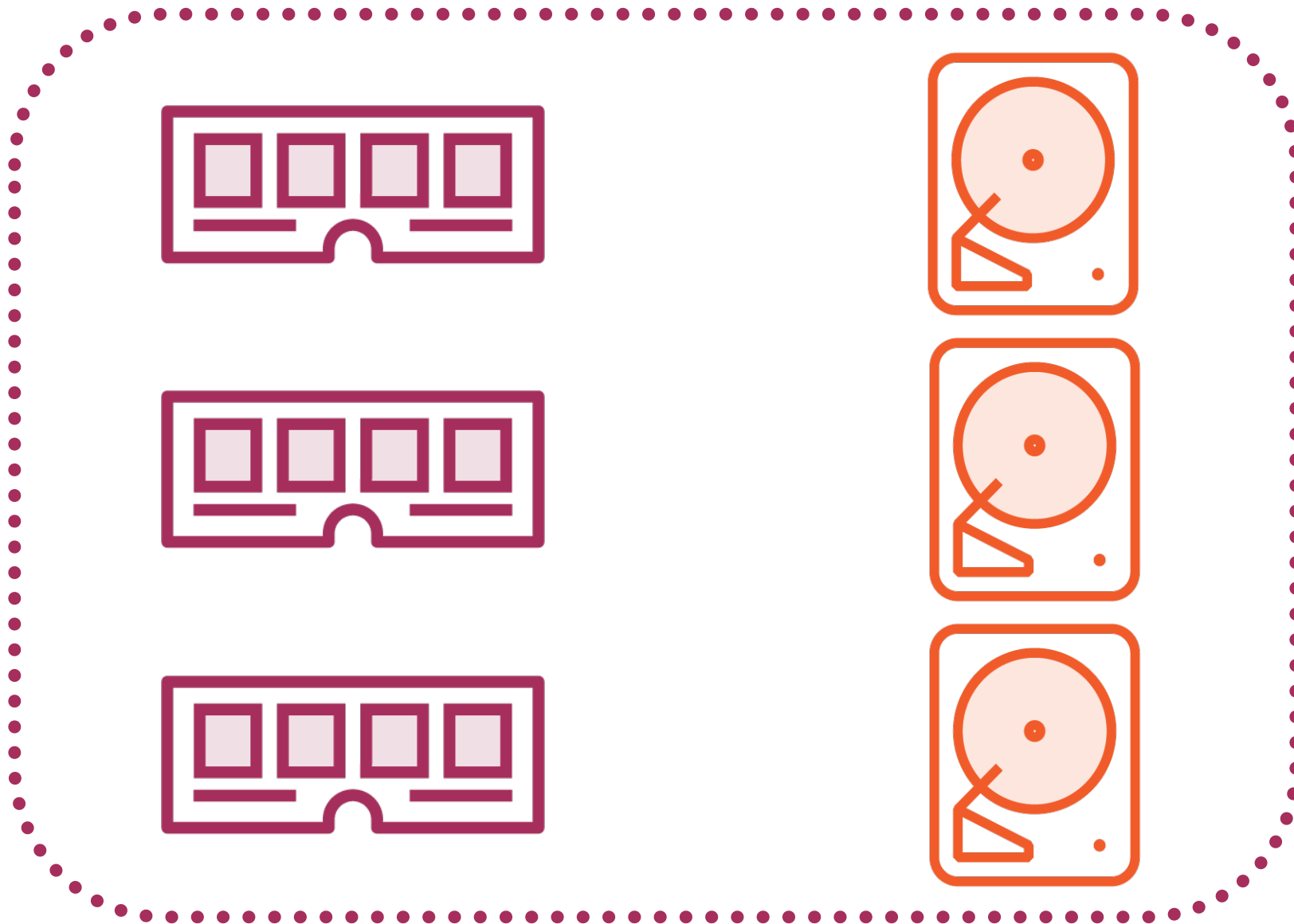




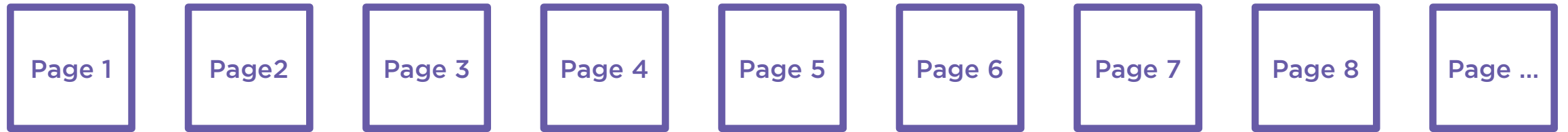


Durable Memory





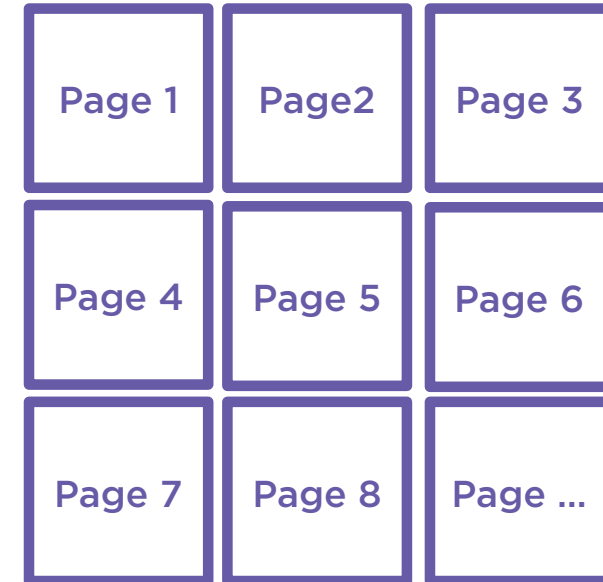
Durable Memory



Durable Memory

On-Heap Memory

Off-Heap Memory



Durable Memory



Durable Memory

Data Region

Data Region

Data Region



Durable Memory



The diagram illustrates the structure of Durable Memory. It consists of a large outer rectangle with an orange border. Centered within this rectangle is a smaller rectangle with a dark red border. The text "Data Region" is centered inside the smaller rectangle.

Data Region



Durable Memory



The diagram illustrates the structure of Durable Memory. It consists of a large orange rectangular frame. Inside this frame, centered horizontally and vertically, is a smaller purple rectangular frame. The text "Data Region" is centered within the purple frame.

Data Region



Durable Memory



Durable Memory



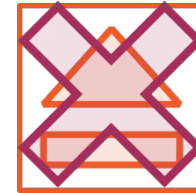
Durable Memory



Durable Memory

20%

Default Data Region



Cache Mode Configuration

```
<bean class="org.apache.ignite.configuration.IgniteConfiguration">
<property name="dataStorageConfiguration">
  <bean class="org.apache.ignite.configuration.DataStorageConfiguration">
    <property name="dataRegionConfigurations">
      <list>
        <bean class="org.apache.ignite.configuration.DataRegionConfiguration">
          <property name="name" value="500MB_Region" />
          <property name="initialSize" value="#{100L * 1024 * 1024}" />
          <property name="maxSize" value="#{500L * 1024 * 1024}" />
          <property name="persistence" value="true" />
          <property name="pageEvictionMode" value="RANDOM_2_LRU" />
        </bean>
      </list>
    </property>
  </bean>
</property>

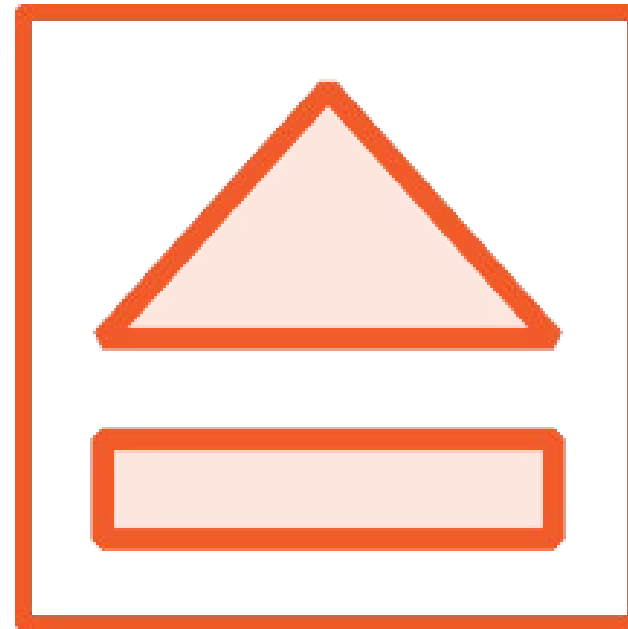
<!-- The rest of the configuration. -->
</bean>
```



Durable Memory



Random LRU
Random 2 LRU
Disabled



Durable Memory

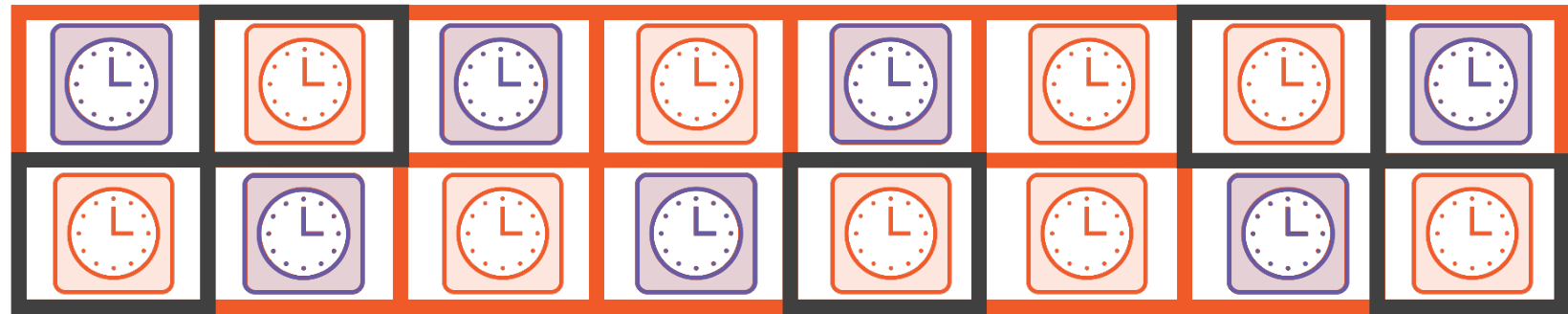
On-Heap Memory

Off-Heap Memory

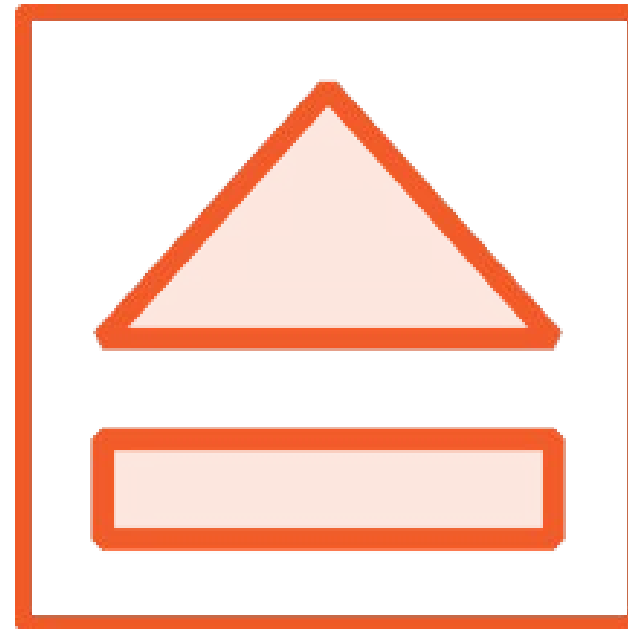


Durable Memory

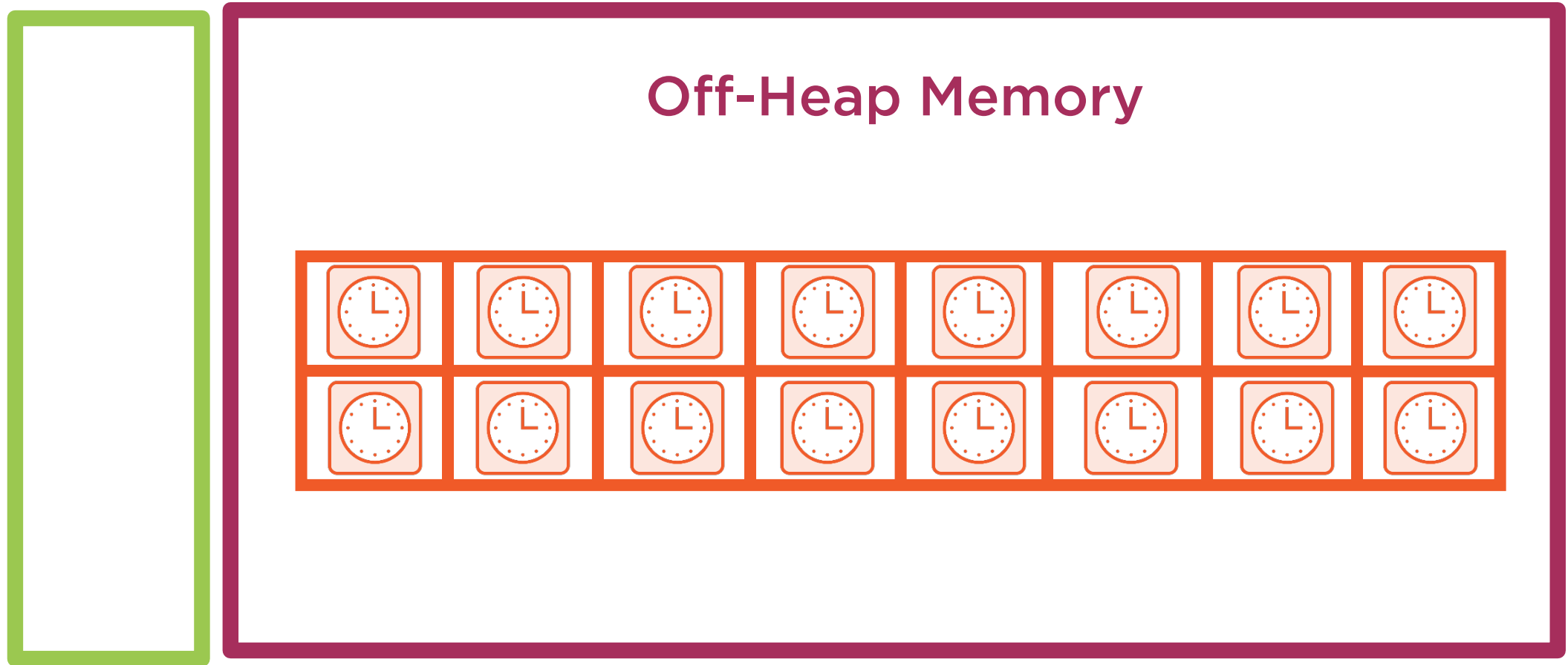
Off-Heap Memory



Random LRU
Random 2 LRU

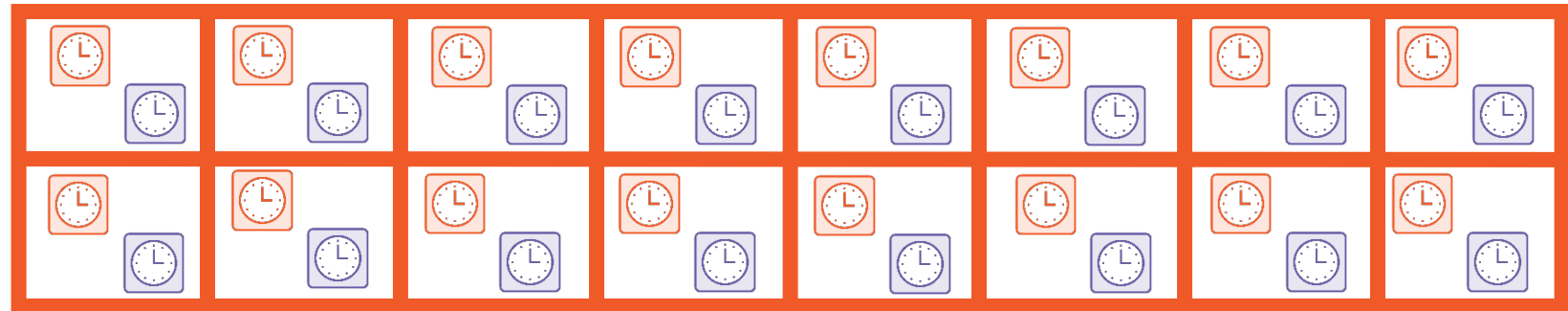


Durable Memory

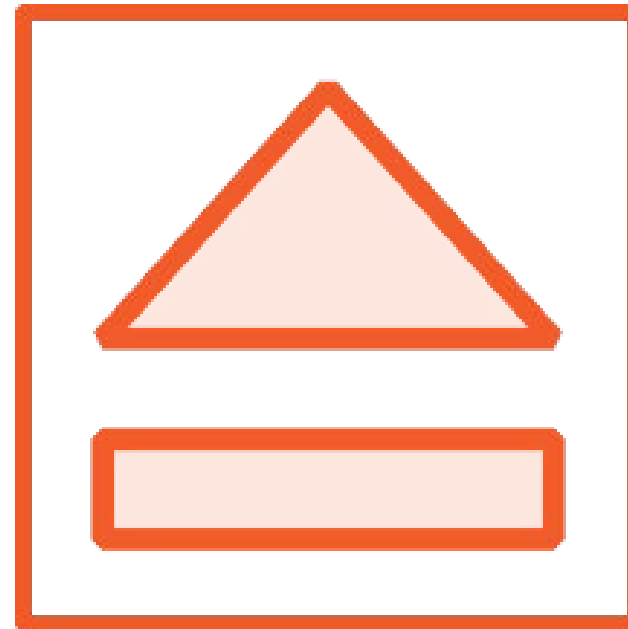


Durable Memory

Off-Heap Memory



Random LRU
Random 2 LRU
Disabled



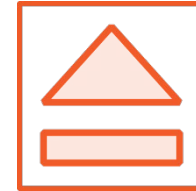
Durable Memory

Data Region



Durable Memory

Data Region



Durable Memory



A diagram showing a large orange rectangular frame. Inside this frame, centered horizontally and vertically, is a smaller purple rectangular frame. The text "Data Region" is centered within the purple frame.

Data Region



Durable Memory

Altered Data Region



Durable Memory

In-Memory Only Data Region



Durable Memory



A diagram showing a large orange rectangular frame containing a smaller, horizontally-oriented purple rectangular frame in the center. The purple frame is labeled "Data Region".

Data Region



Durable Memory

Data Region

Memory Segment

Memory Segment

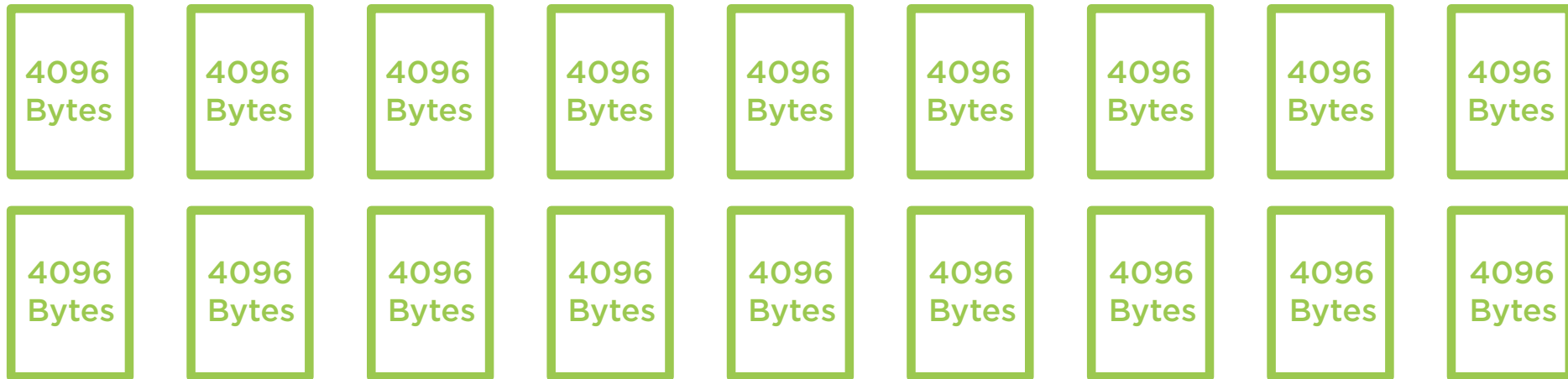
Memory Segment



Durable Memory

Data Region

Memory Segment



Write Amplification

A ratio of actual data written versus the space that the data takes on the device



Durable Memory

On-Heap Memory

Off-Heap Memory

10011
01011
0010
10011

10011
01011
0010
10011

10011
01011
0010
10011

10011
01011
0010
10011

10011
01011
0010
10011



Expiry Policy



	Created	Last Accessed	Last Updated
CreatedExpiryPolicy	✓		
AccessedExpiryPolicy	✓	✓	
ModifiedExpiryPolicy	✓		✓
TouchedExpiryPolicy	✓	✓	✓
EternalExpiryPolicy			



Expiry Policy

```
<bean id="expiryPolicy"  
    class="javax.cache.configuration.  
    FactoryBuilder$SingletonFactory">  
    <constructor-arg>  
        <bean class="javax.cache.expiry.CreatedExpiryPolicy">  
            <constructor-arg>  
                <bean class="javax.cache.expiry.Duration">  
                    <constructor-arg  
                        type="java.util.concurrent.TimeUnit"  
                        value="MINUTES" />  
                    <constructor-arg value="20" />  
                </bean>  
            </constructor-arg>  
        </bean>  
    </constructor-arg>  
</bean>
```



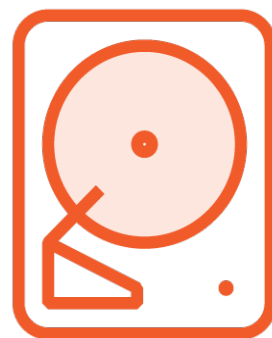
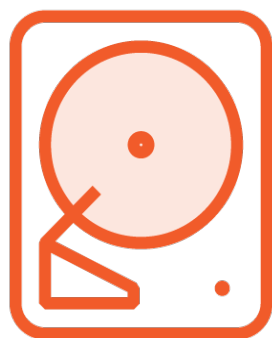
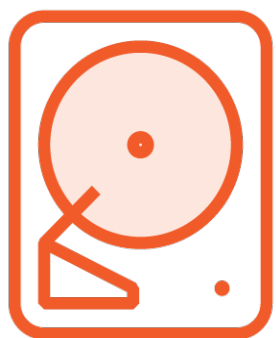
Cache Mode Configuration

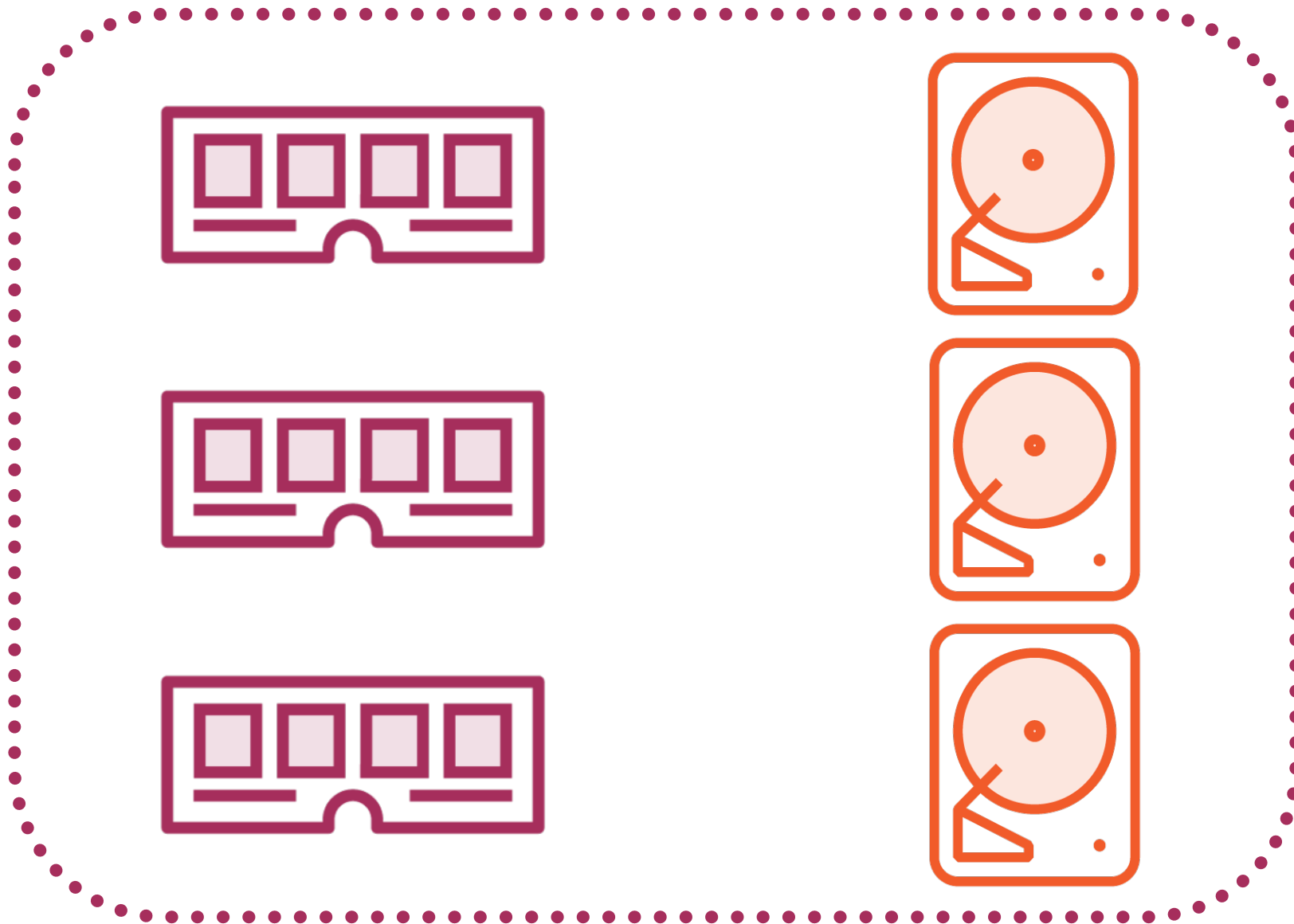
```
<bean class="org.apache.ignite.configuration.IgniteConfiguration">
  <property name="dataStorageConfiguration">
    <bean class="org.apache.ignite.configuration.DataStorageConfiguration">
      <property name="dataRegionConfigurations">
        <list>
          <bean class="org.apache.ignite.configuration.DataRegionConfiguration">
            ...
            <property name="pageEvictionMode" value="RANDOM_2_LRU" />
            <property name="expiryPolicyFactory">
              <bean parent="expiryPolicy" />
            </property>
          </bean>
        </list>
      </property>
    </bean>
  </property>
</bean>
```

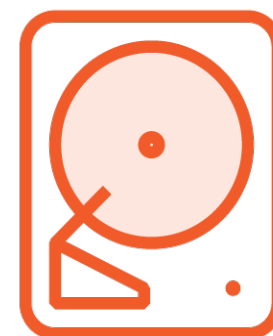
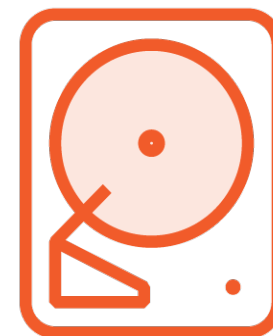
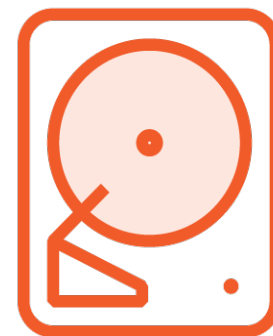


Native Persistence



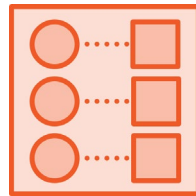
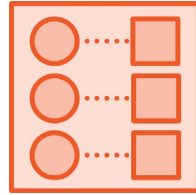
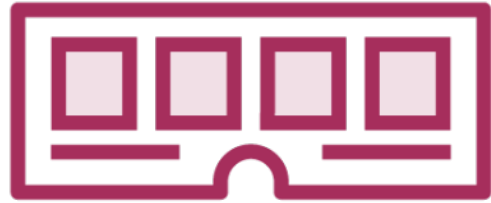
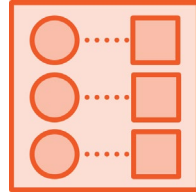
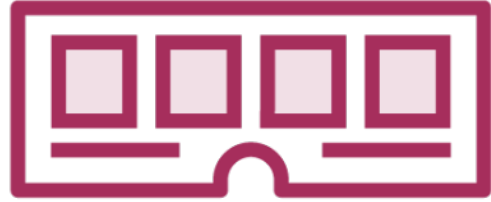














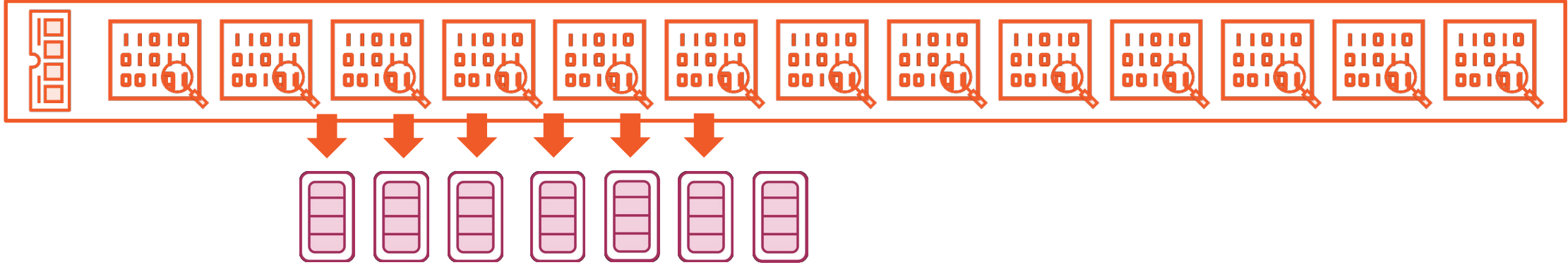


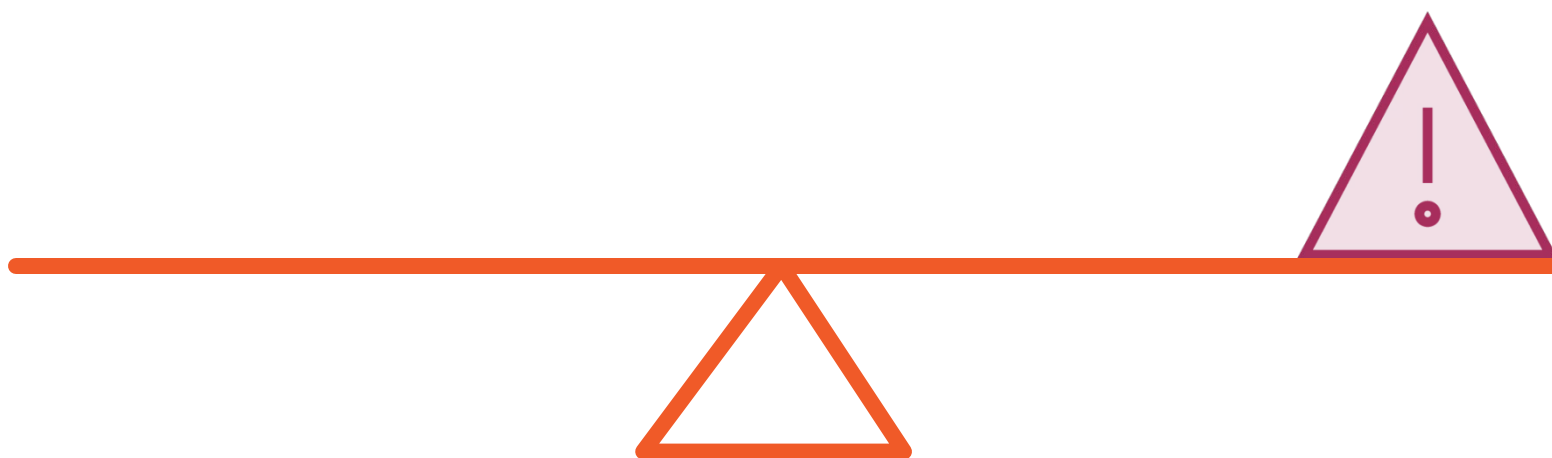
Memory

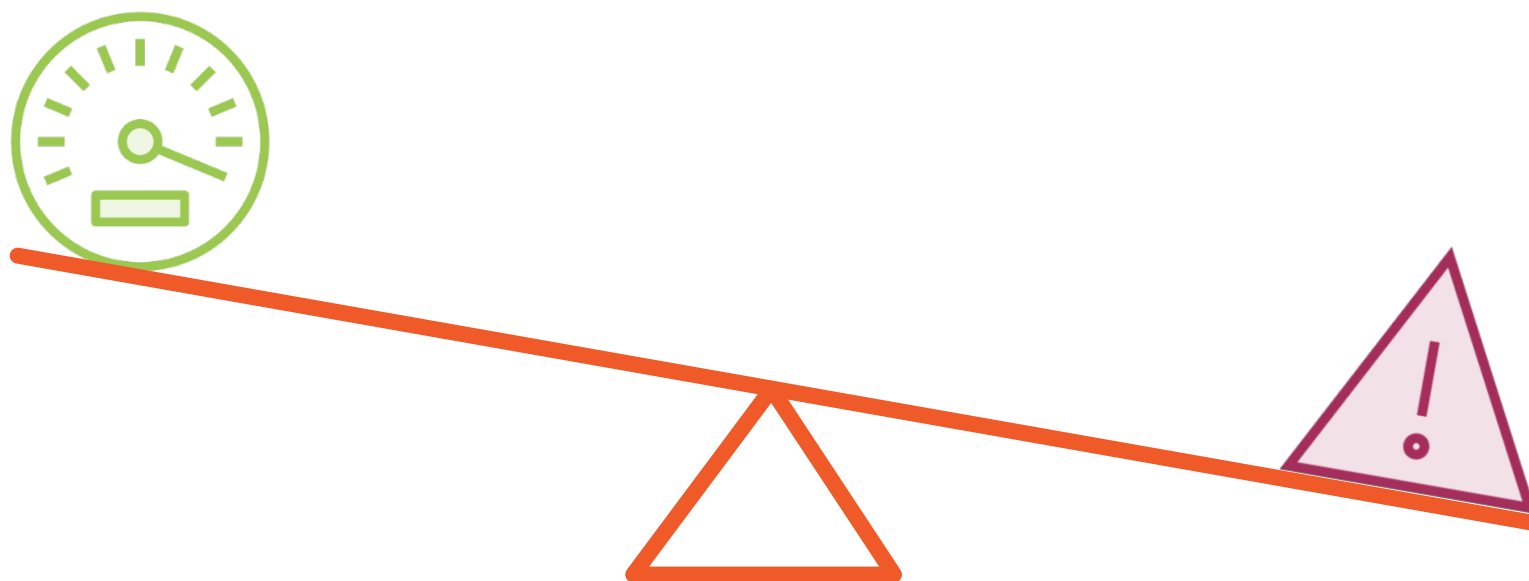


Write-Ahead Log











Using Memory Mapping



`IGNITE_WAL_MMAP = False`



WAL_LOG Modes



FSYNC: Every atomic write or transactional commit is written to disk



LOG_ONLY: If memory mapping is enabled then uses memory mapped files. Otherwise uses OS cache.




BACKGROUND: If memory mapping is enabled then behaves like LOG_ONLY. Otherwise it's periodically flushed to disk



NONE: Write ahead log is completely disabled.





11010
01011
00101

11010
01011
00101

11010
01011
00101

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00101

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11010
01011
00101

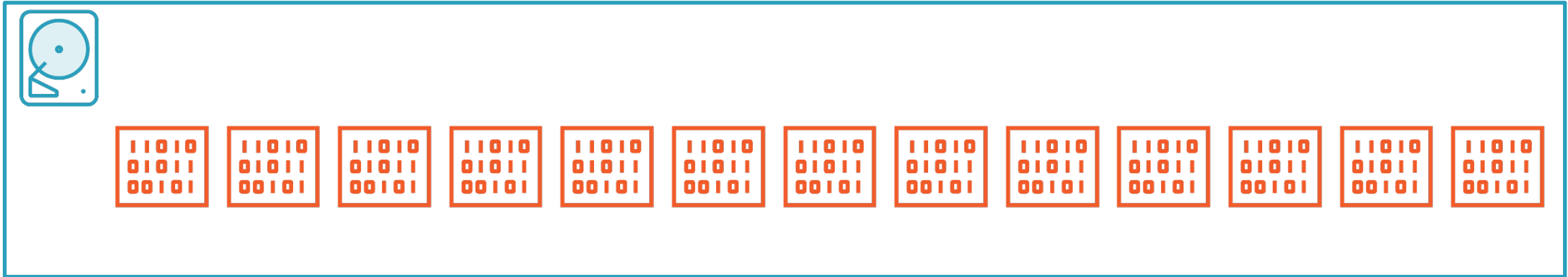
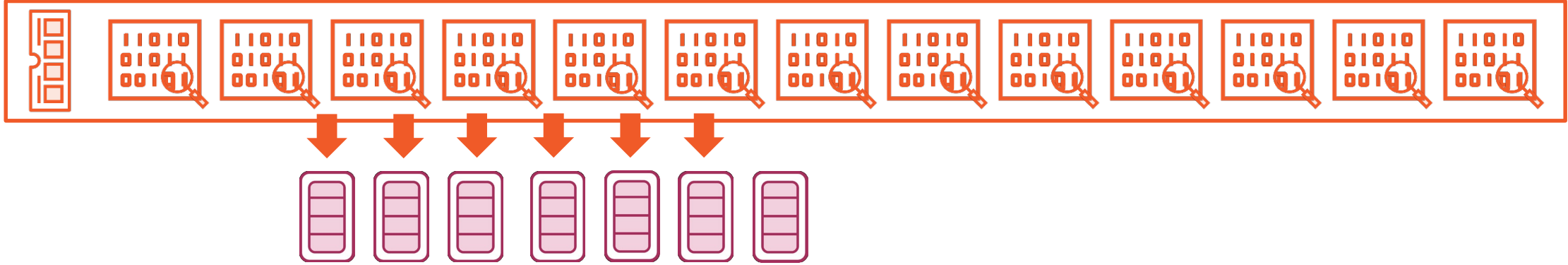




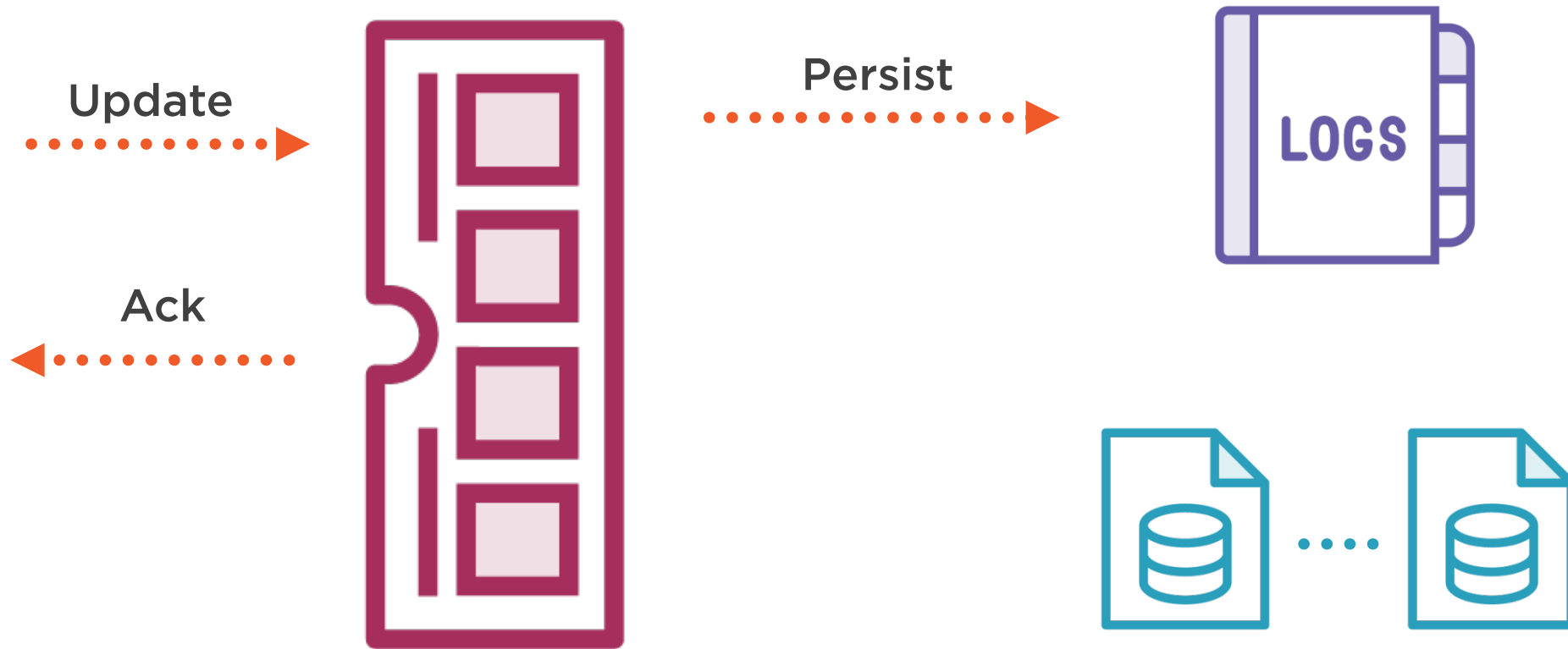
LOGS



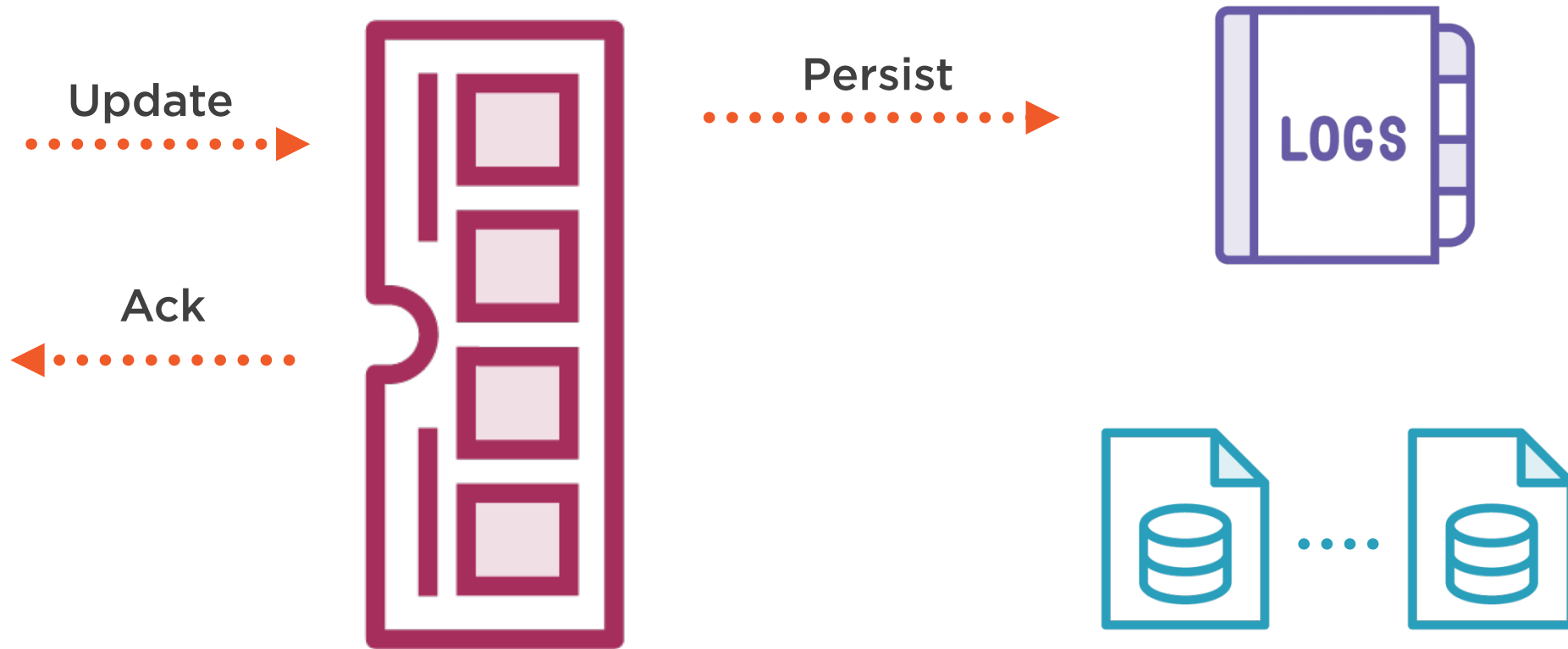




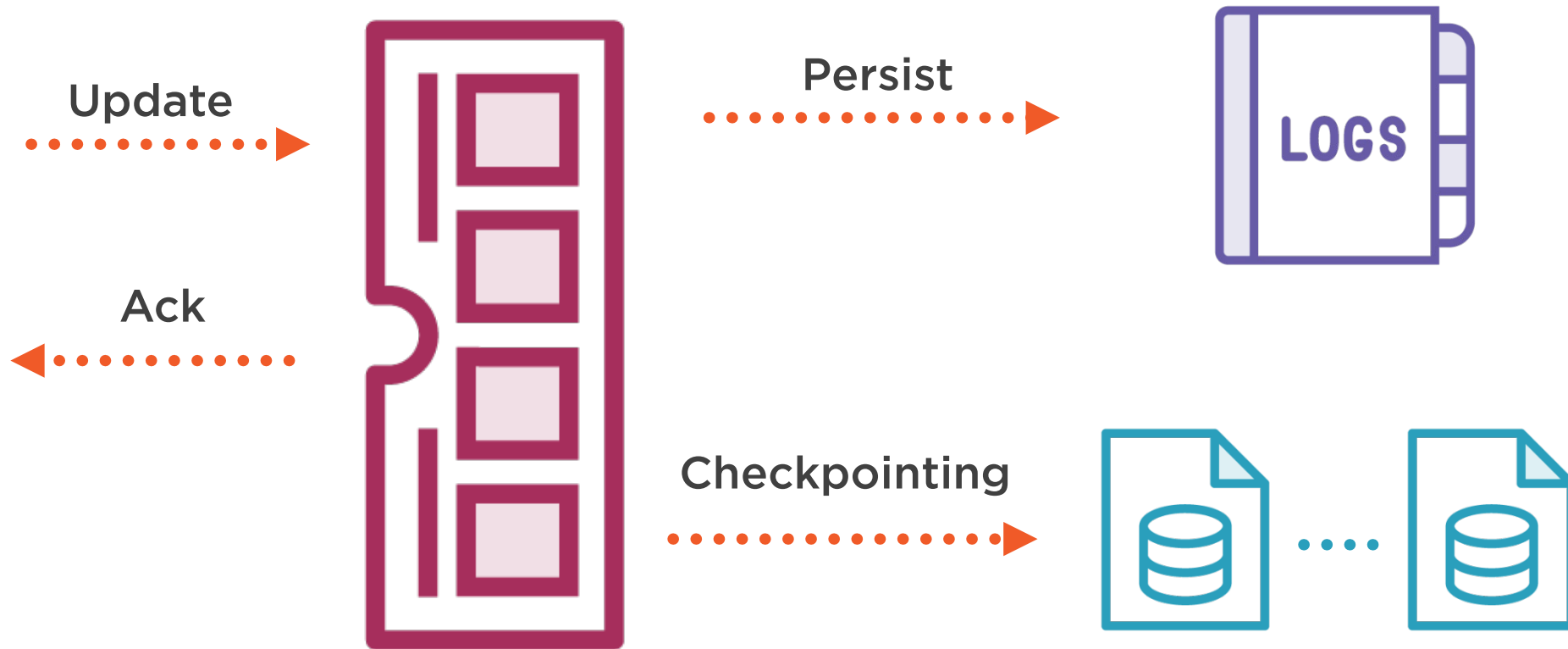
Server Node

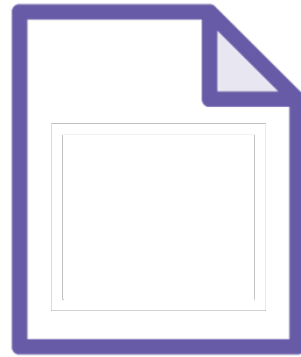
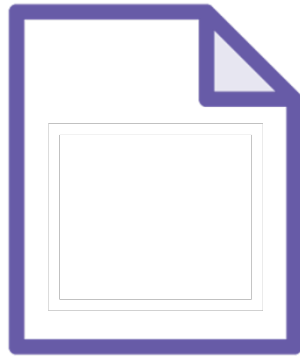
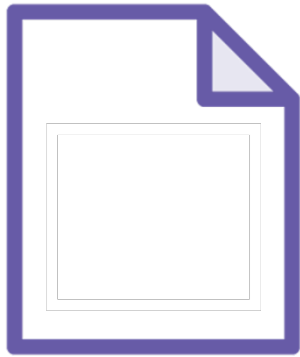
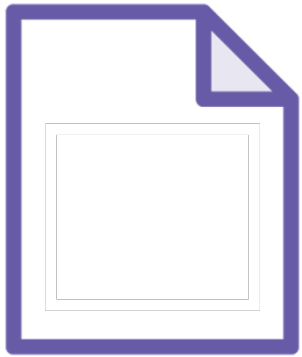


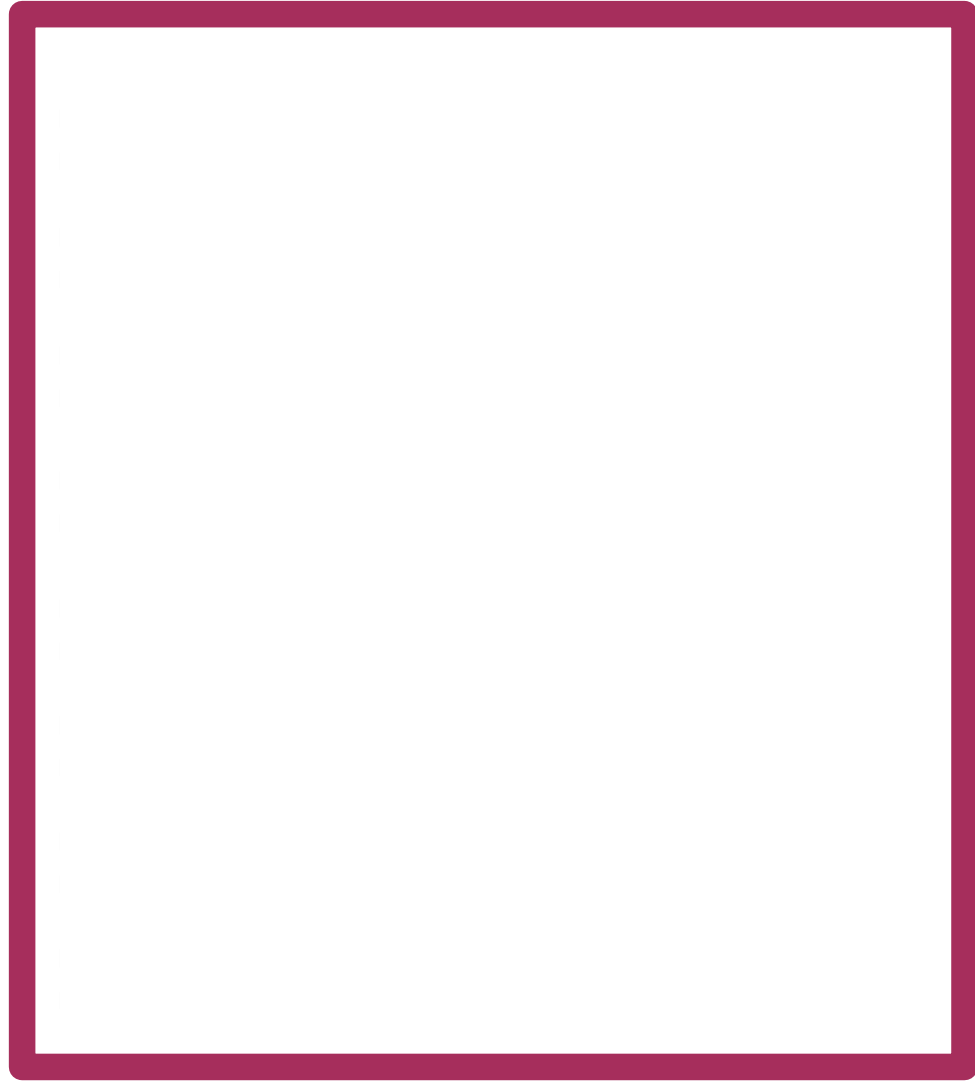
Server Node



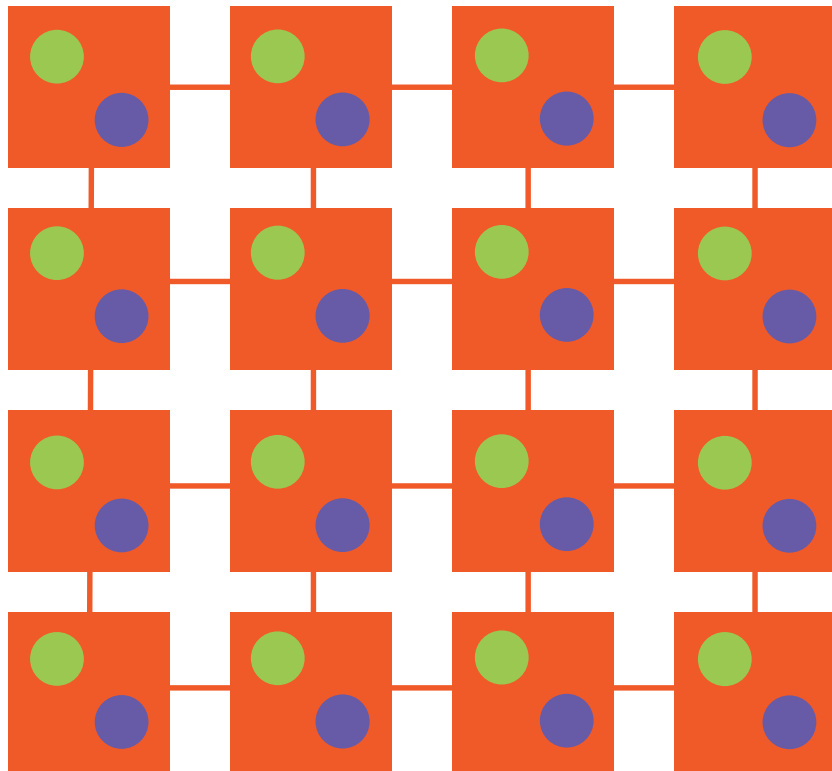
Server Node







Ignite Caches



Aircraft cache

- Aircraft data type
- Aircraft domain model



Flight plans cache

- Flight plans data type
- Flight plans domain model





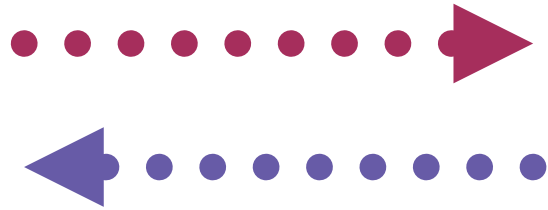
Flight plans cache

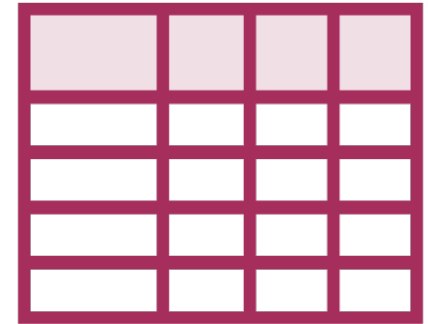
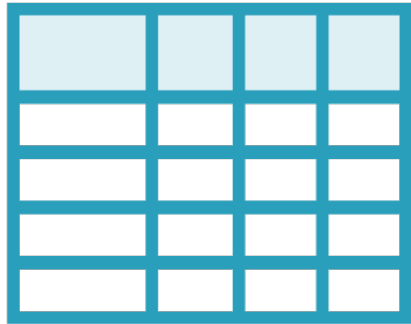
- Flight plans data type
- Flight plans domain model

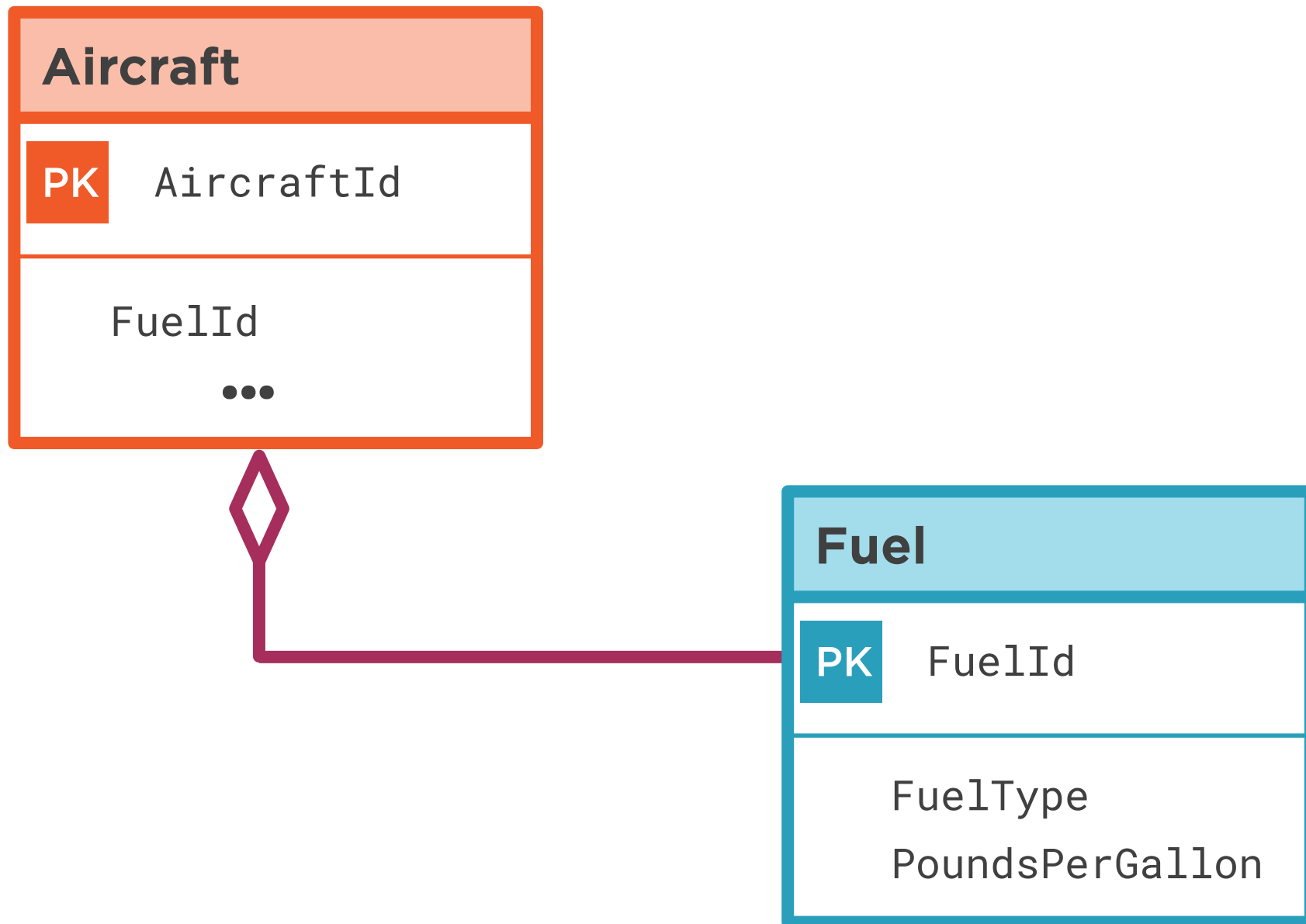


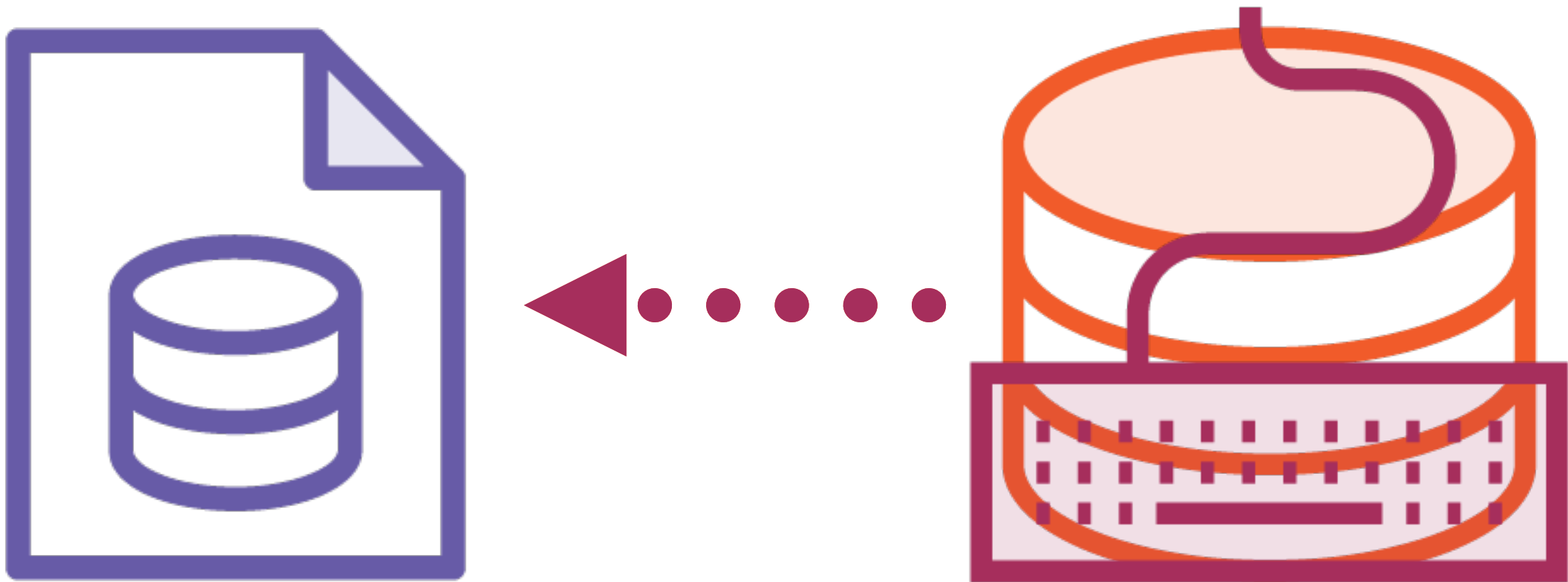


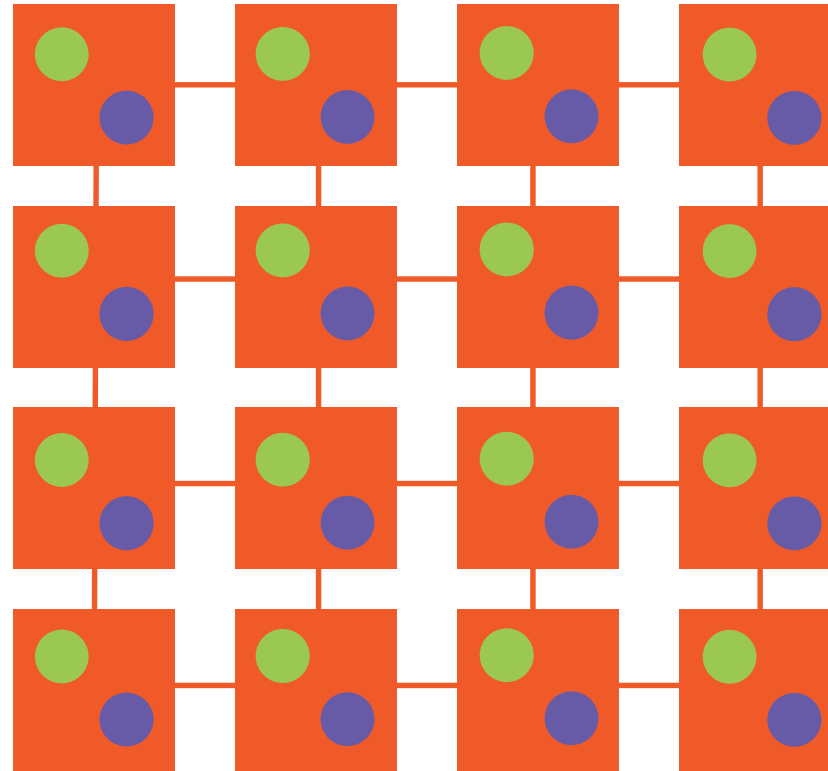
Partitioned











Clustering



Aircraft

Primary

Airports

Backup

Routes

Primary

Aircraft

Backup

Airports

Primary

Routes

Backup

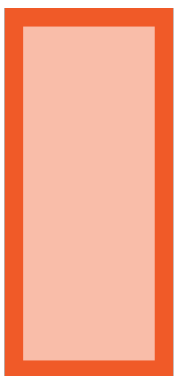


Up Next

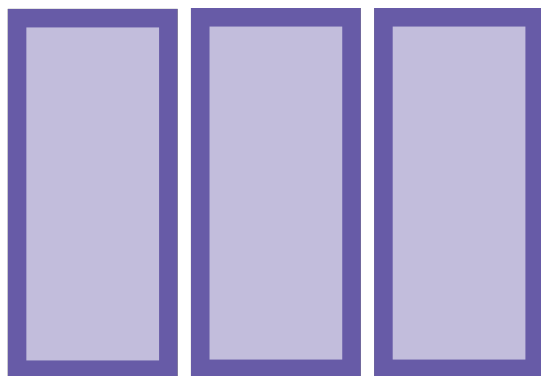
Configuration



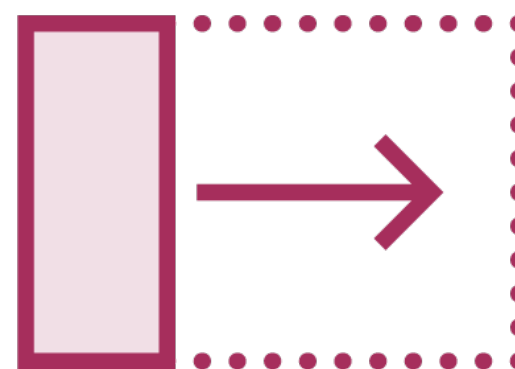
Cache Modes



Local



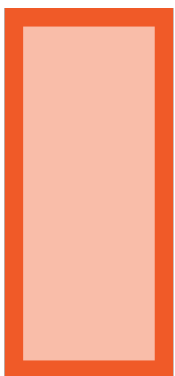
Replicated



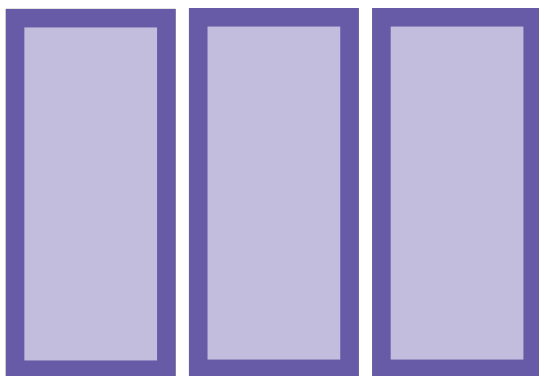
Partitioned



Cache Modes

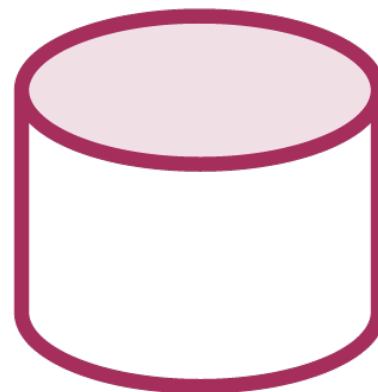
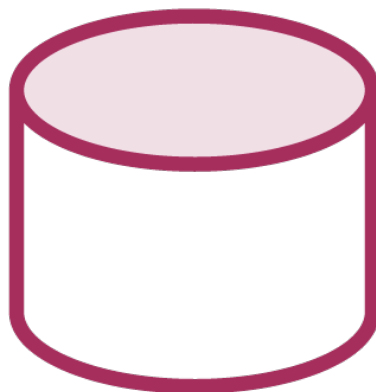
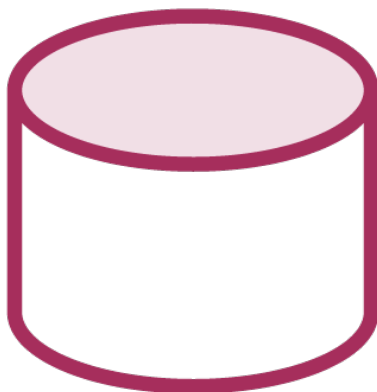
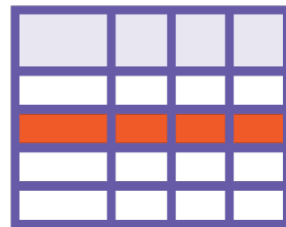


Local



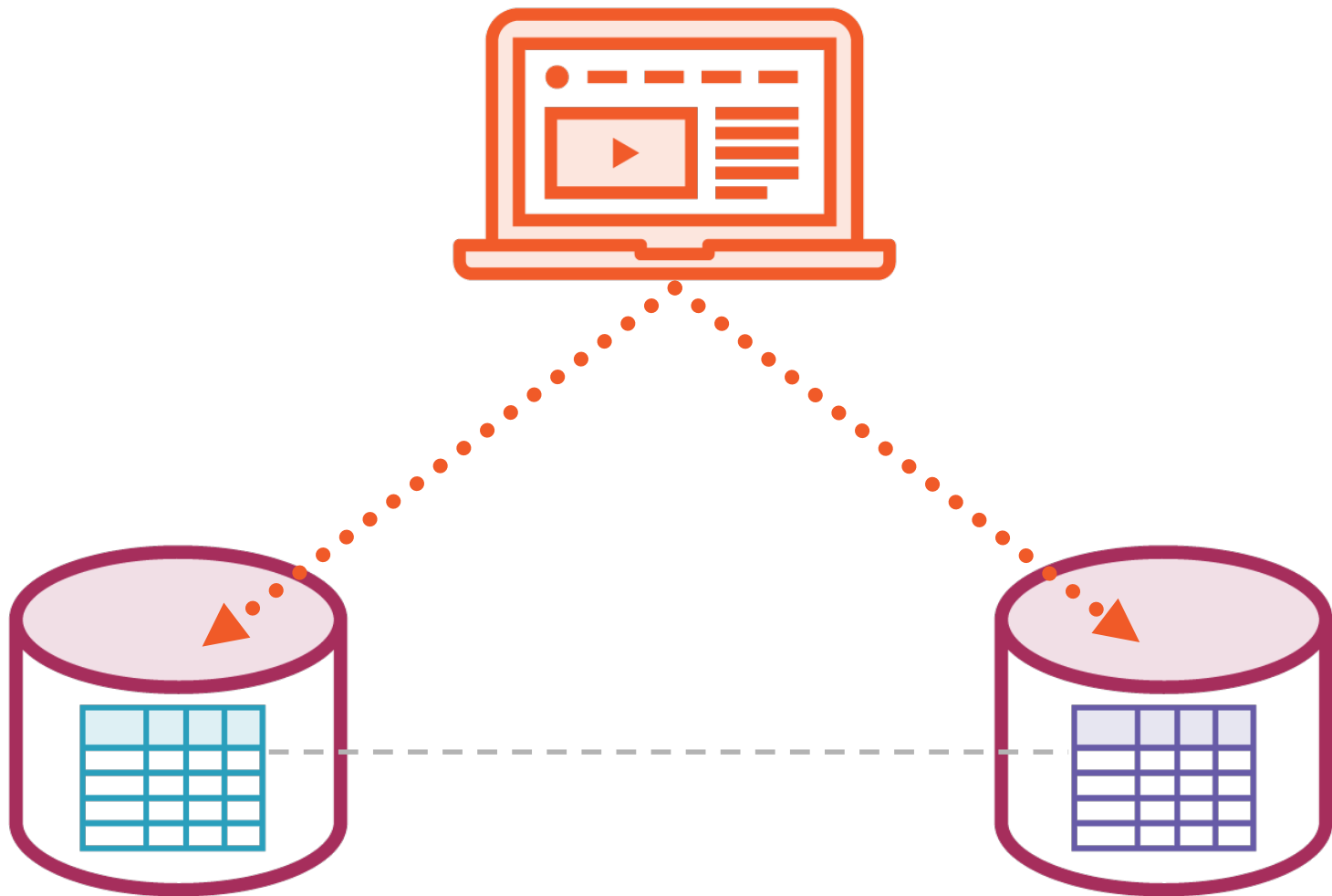
Replicated

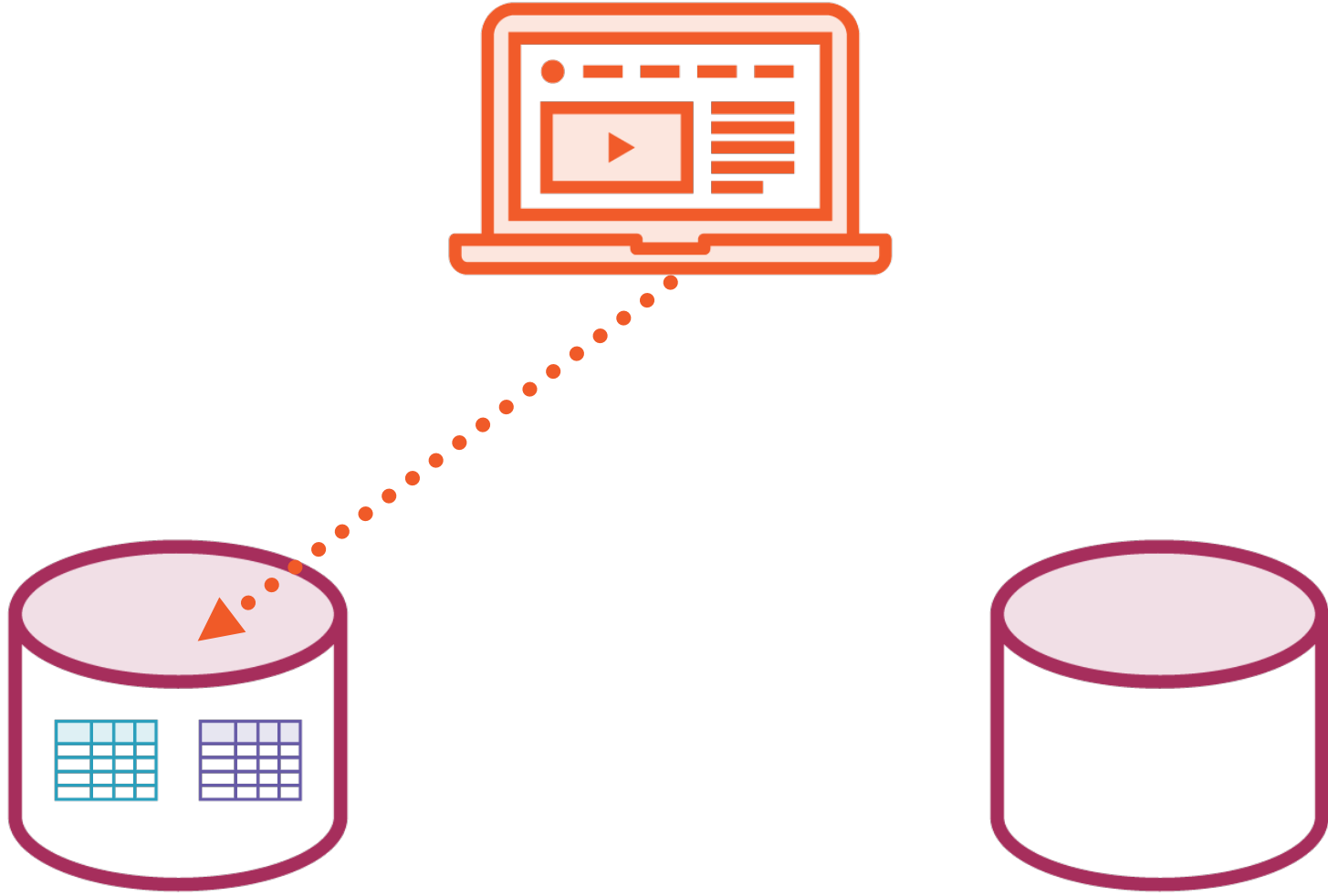


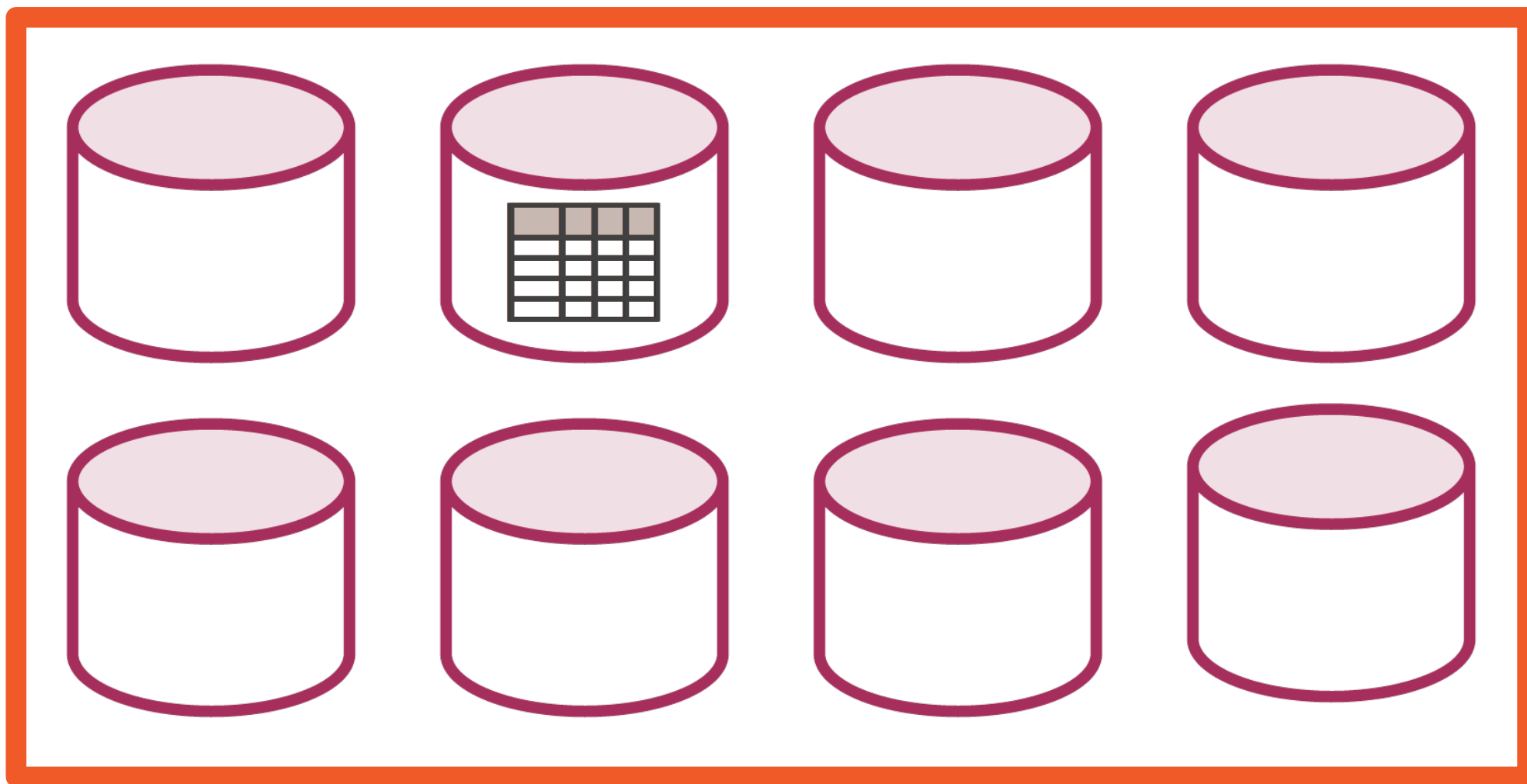










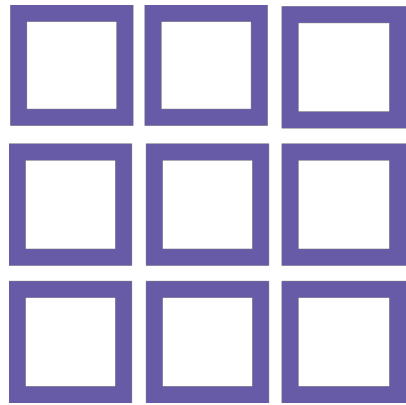


Cache Mode Configuration

```
<bean class="org.apache.ignite.configuration.IgniteConfiguration">
  <property name="cacheConfiguration">
    <list>
      <bean class="org.apache.ignite.configuration.CacheConfiguration">
        <property name="name" value="AircraftCache" />
        <property name="cacheMode" value="PARTITIONED" />
        <property name="backups" value="2" />
        ...
      </bean>
    </list>
  </property>
</bean>
```



Memory Mode

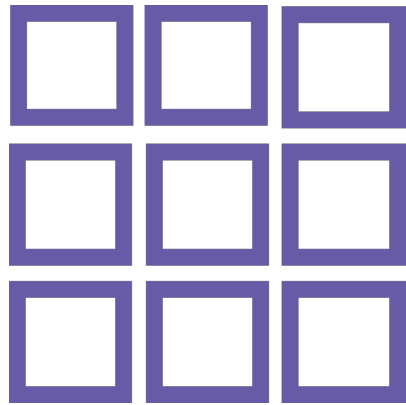


On-heap

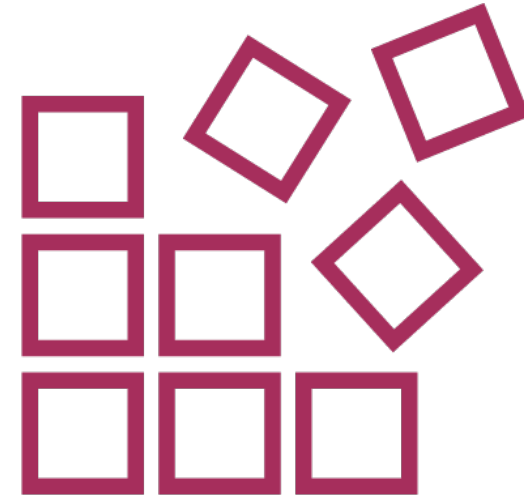


Off-heap

Memory Mode

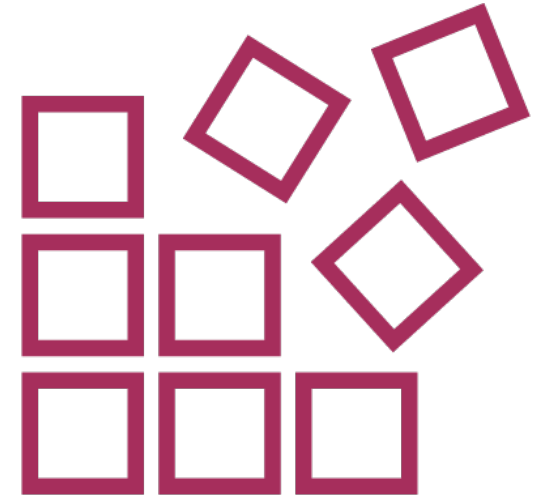


Heap

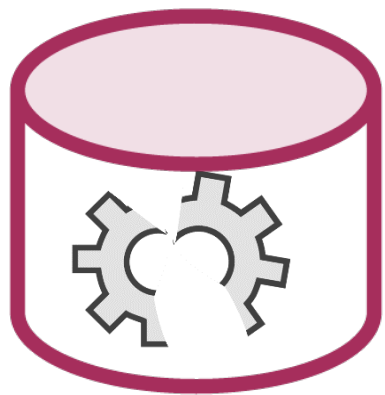


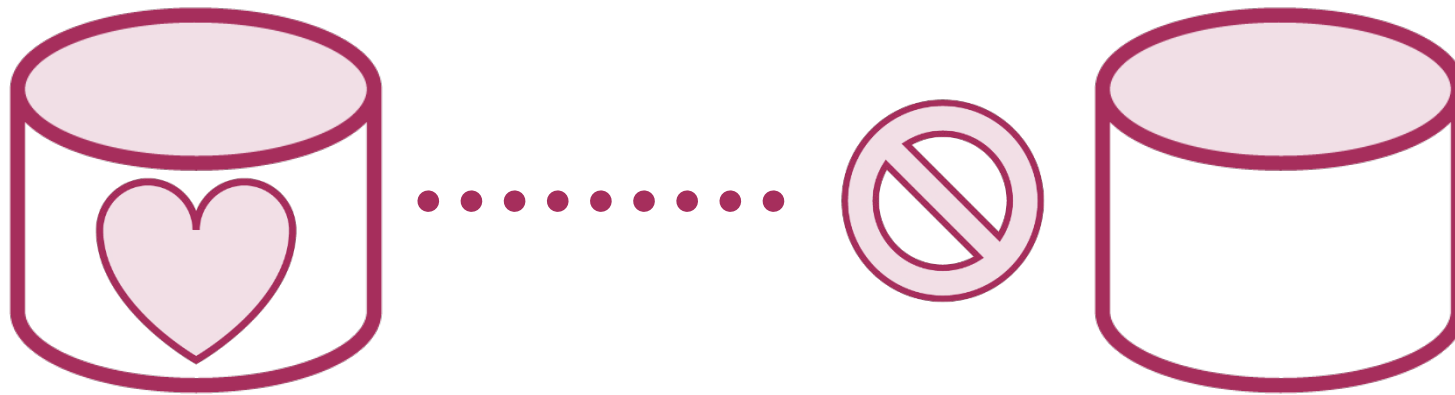
Non-heap

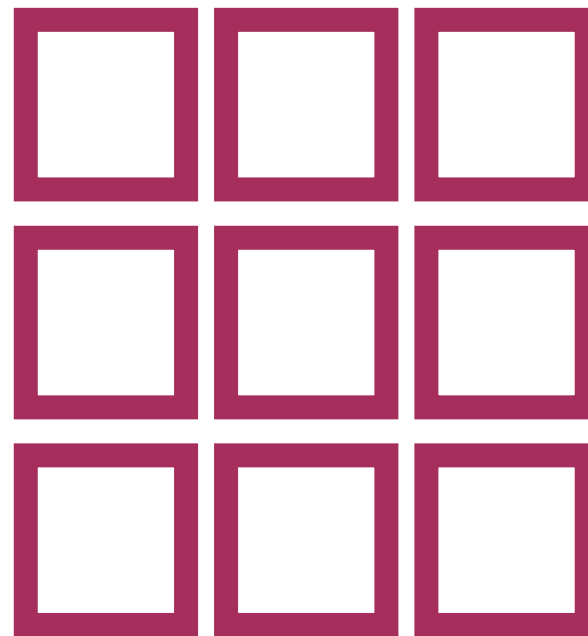
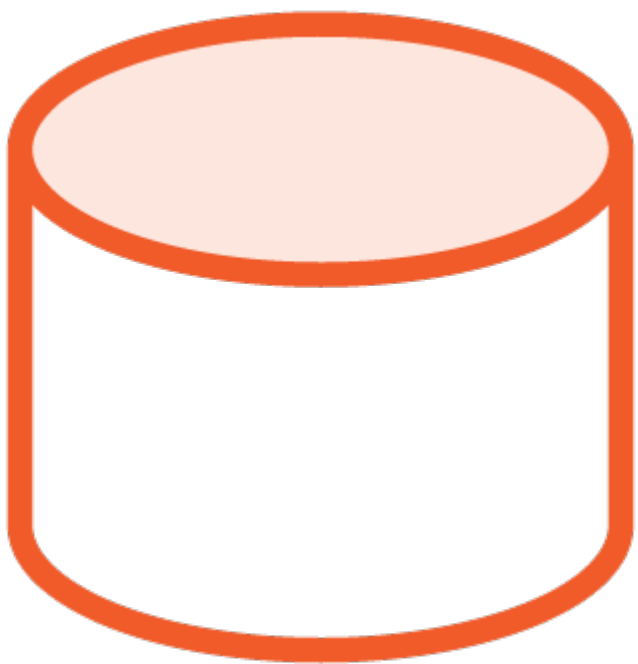
Memory Mode

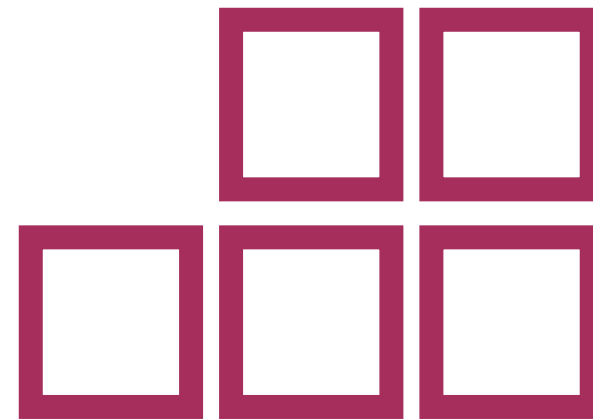


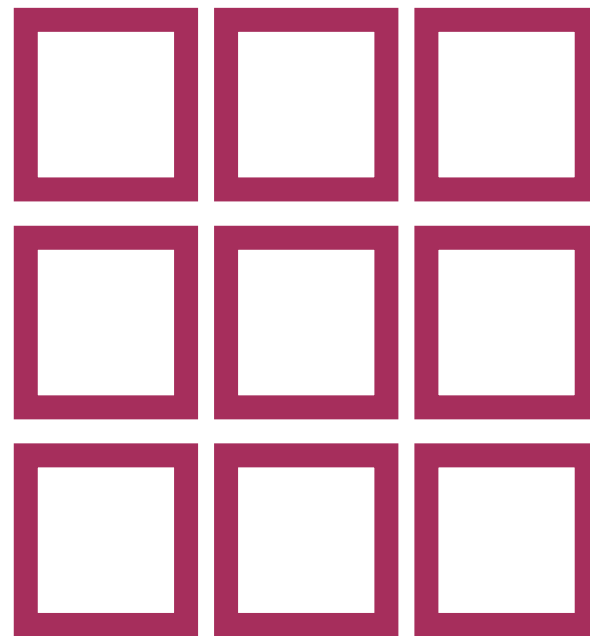
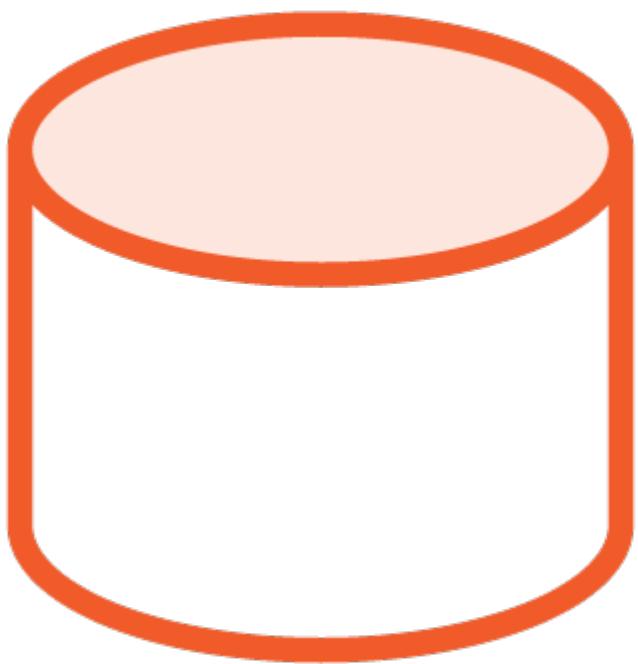
Off-heap

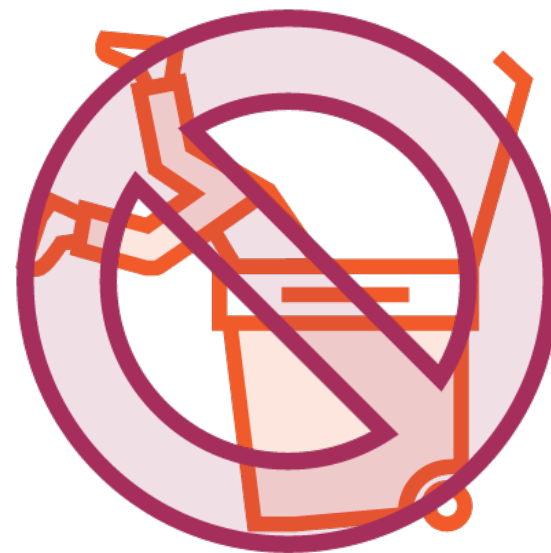
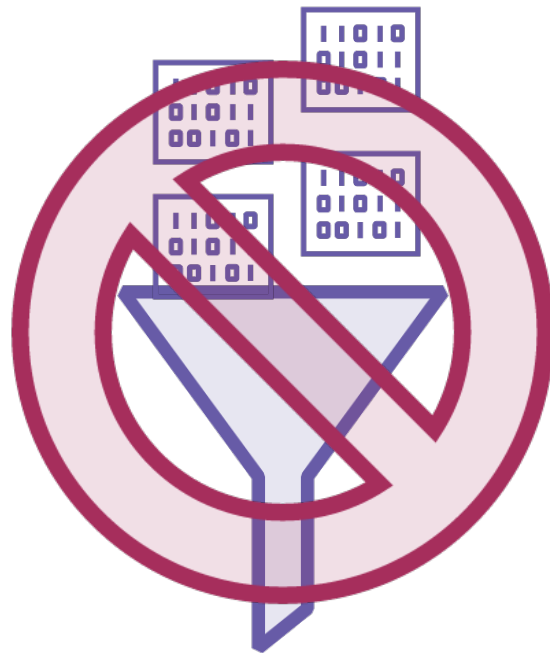












Memory Mode Configuration

```
<bean class="org.apache.ignite.configuration.IgniteConfiguration">
  <property name="cacheConfiguration">
    <list>
      <bean class="org.apache.ignite.configuration.CacheConfiguration">
        <property name="name" value="AircraftCache" />
        <property name="cacheMode" value="PARTITIONED" />
        <property name="onheapCacheEnabled" value="true" />
        ...
      </bean>
    </list>
  </property>
</bean>
```



Write Synchronization



When to complete a write operation

Only applies to caches in partitioned mode

Write Synchronization Modes

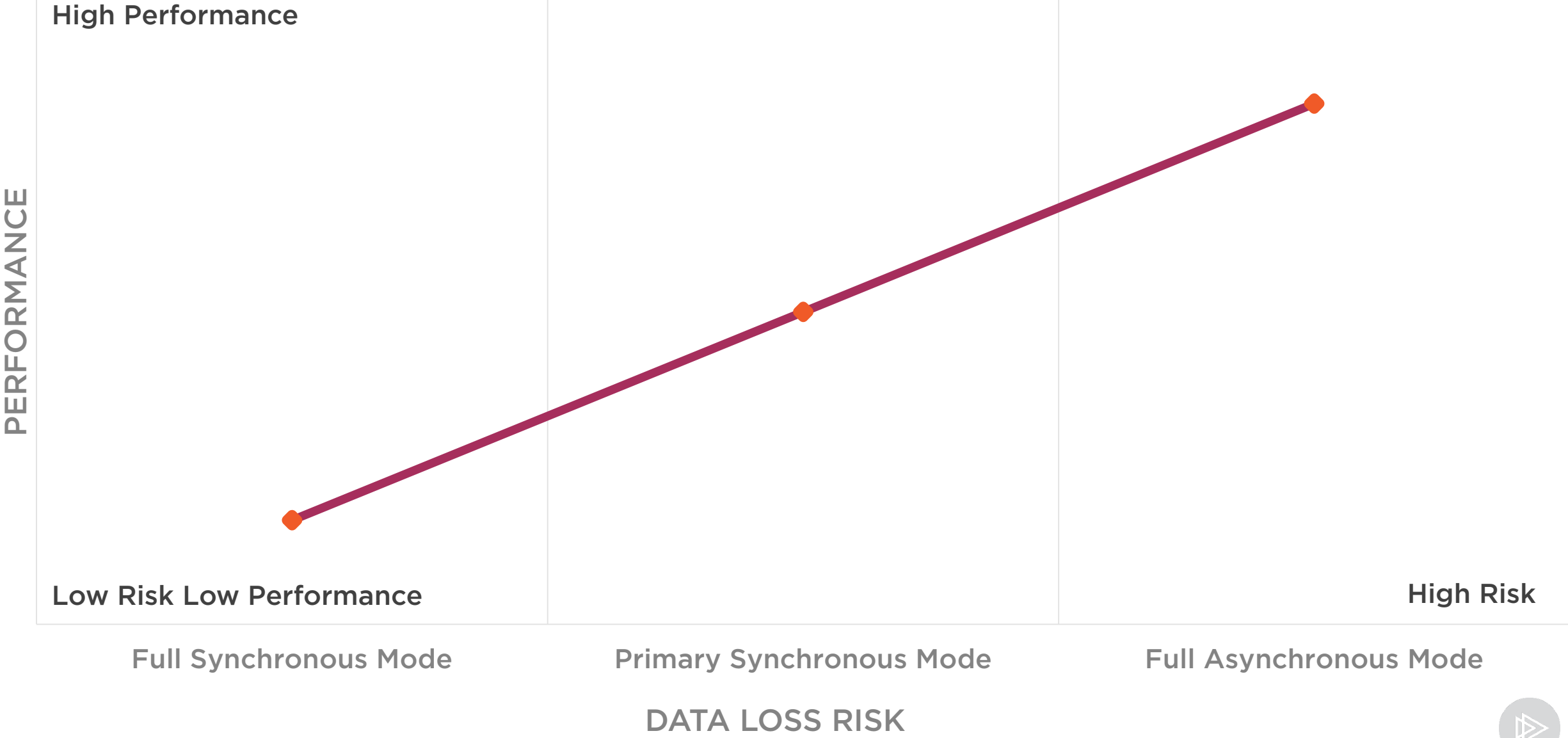
Full-Sync

Full-Async

Primary-Sync



DATA LOSS RISK VS. PERFORMANCE



Write-Sync Mode Configuration

```
<bean class="org.apache.ignite.configuration.IgniteConfiguration">
  <property name="cacheConfiguration">
    <list>
      <bean class="org.apache.ignite.configuration.CacheConfiguration">
        <property name="name" value="AircraftCache" />
        <property name="cacheMode" value="PARTITIONED" />
        <property name="writeSynchronizationMode" value="FULL_SYNC" />
        ...
      </bean>
    </list>
  </property>
</bean>
```



TRANSACTION RISK VS. TIME

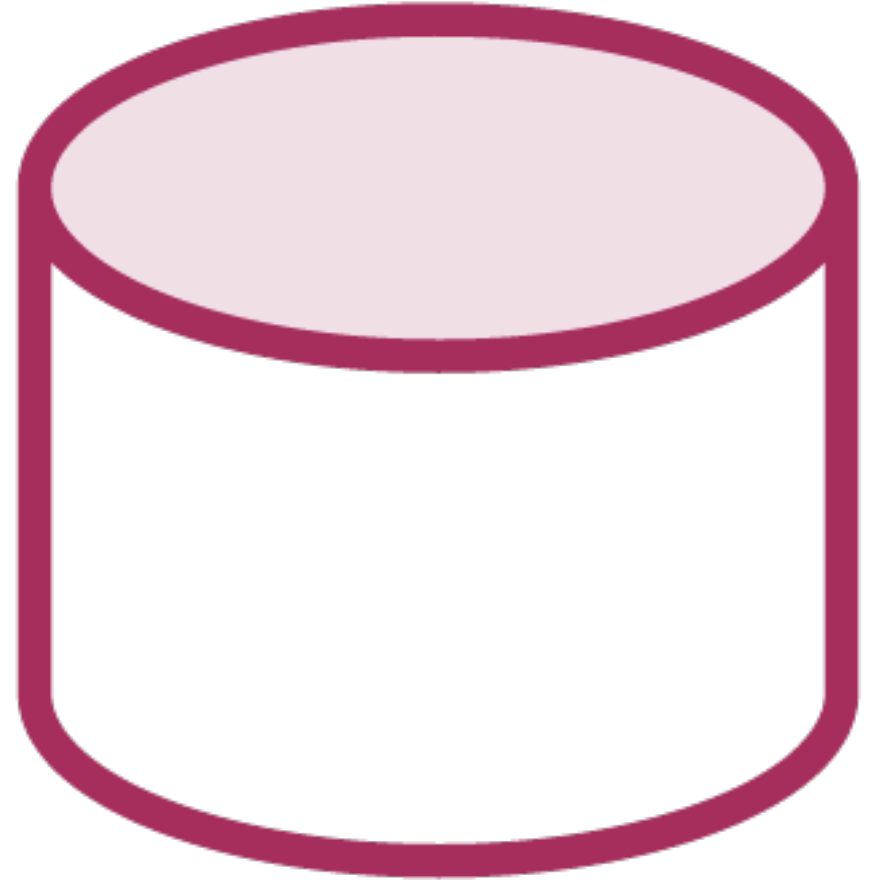
■ Transaction ■ Atomic

PERFORMANCE



RISK





Atomicity Mode Configuration

```
<bean class="org.apache.ignite.configuration.IgniteConfiguration">
  <property name="cacheConfiguration">
    <list>
      <bean class="org.apache.ignite.configuration.CacheConfiguration">
        <property name="name" value="AircraftCache" />
        <property name="cacheMode" value="PARTITIONED" />
        <property name="atomicityMode" value="ATOMIC" />
        ...
      </bean>
    </list>
  </property>
</bean>
```



Data APIs

JCache API

SQL Grid API





Basic data operations



C.R.U.D. Operations in JCache

C.R.U.D. Operations

Create

Read

Update

Delete

JCache API

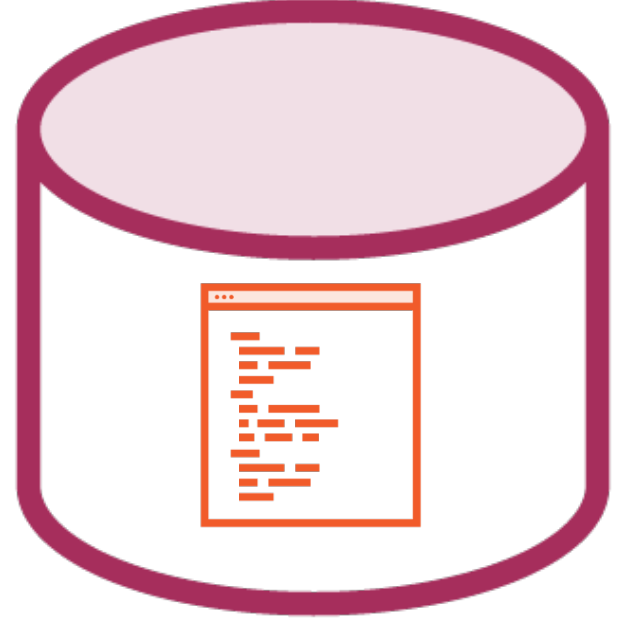
Put

Get

Replace

Clear







Entry Processor

A small amount of code sent from the client to the server to modify some piece of data in a record.

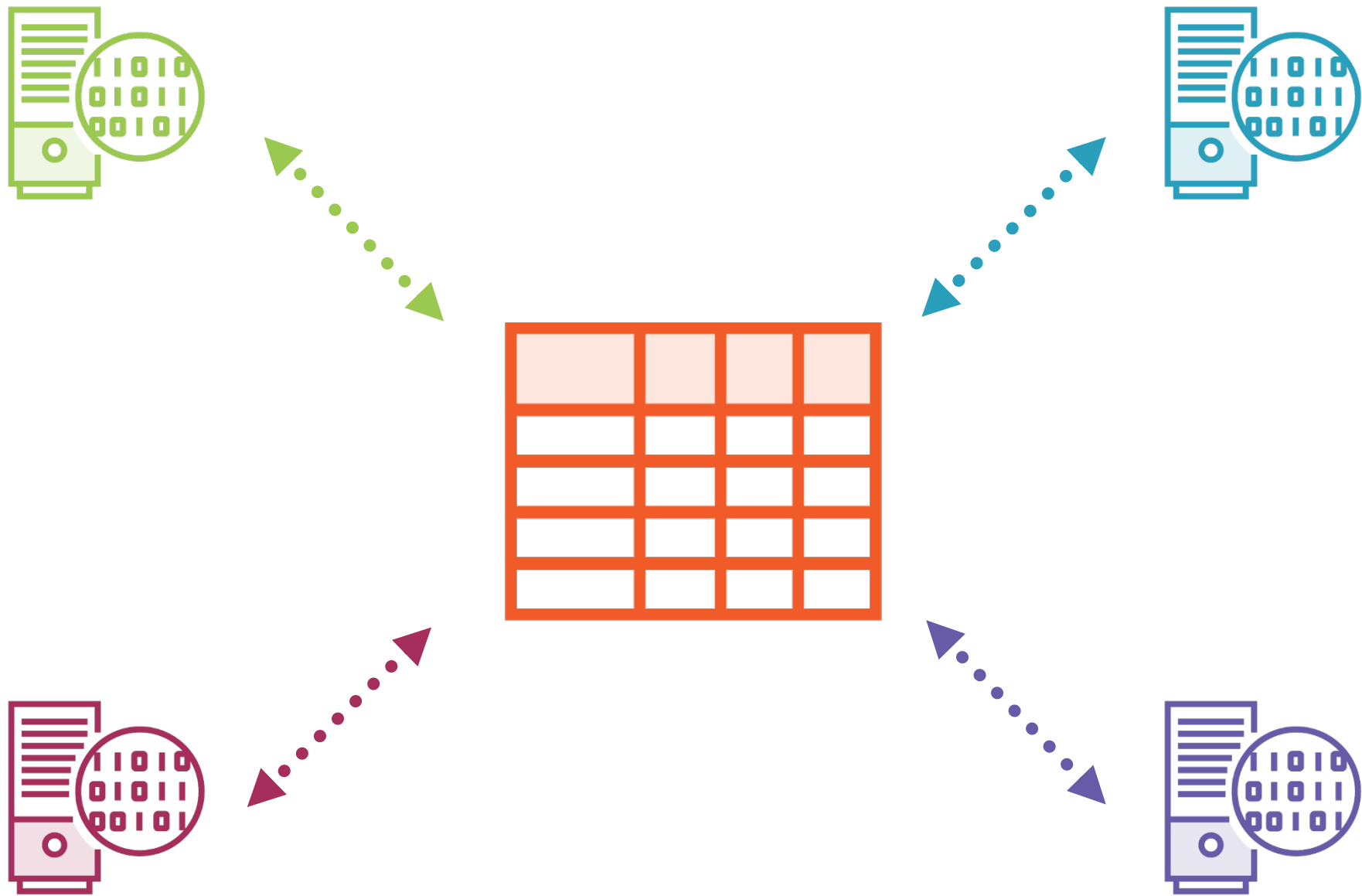




Basic data operations

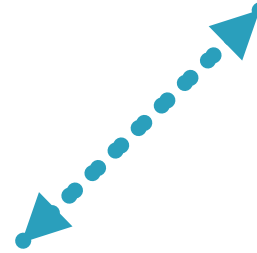
Atomic operations







{Flight: CLE -> SLC}





{Flight: CLE -> SLC}





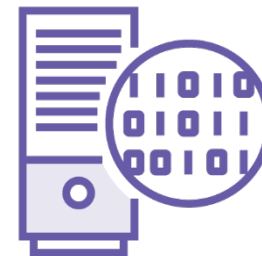
{Flight: CLE -> SLC}







{Flight: CLE -> SLC}			





{Flight: CLE -> SLC}



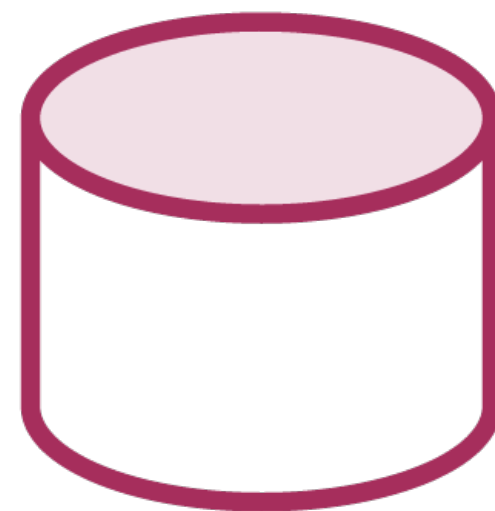


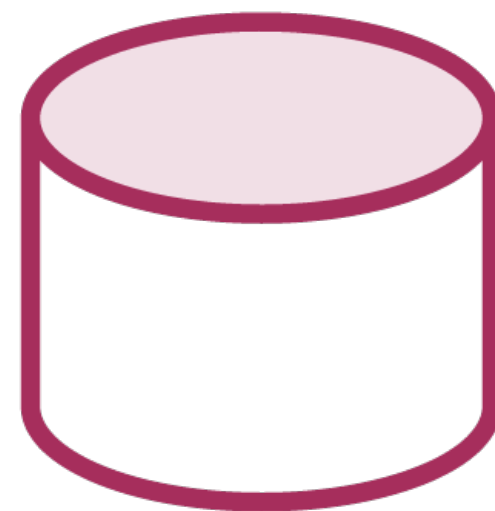


Basic data operations

Atomic operations

Bulk operations





Summary



Durable memory

Native persistence

Caches

JCache API

Configuration