Auto Scaling of Key Value stores

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Outline

1. Abstract
2. Introduction
3. Experiments
4. Observations
5. Further works

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Aim

- Collect statistics for different queries on different scaling configurations and try to find possible bottlenecks in the system.
- Providing an auto-scaling solution for key value stores.

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Key Value Stores

- Data is organized in just 2 columns - a **key**, and a **value**.
- Actual data is value - can be object, keys are used to index these data objects.
- Satisfy **BASE** property.
  - Basically Available
  - Soft state
  - Eventually consistent
- **CAP** theorem
  - Consistency
  - Availability
  - Partition tolerance
- Fall into CP category.
- Mostly In-memory - extremy fast compared to traditional DBs.

Scalability

- *def:* Property of a system to handle a growing amount of work by adding resources to the system[Bondi, Andre - 2000].
- Two variants:
  - **Vertical Scaling:** Increasing the resources in the server which we are currently using, i.e increase the amount of memory, CPU etc.
  - **Horizontal Scaling:** Increasing the number of servers (instances).
- Benefits of horizontal scaling:
  - make system fault tolerant.
  - down time.
- Several load balancing schemes are used in horizontal scaling.

Redis

- developed by Salvatore Sanfilippo(*antirez*).
- Open source, in-memory data structure store, used as a database, cache and message broker.
- Supports other data structures like: strings, hashes, lists, sets, sorted sets with range queries, bitmaps, hyperloglogs.
- Built in support for replication, on-disk persistance and automated partitioning with Redis cluster.
- Master-slave asynchronous replication.
- Transaction, expiration time (BigTable).

Redis Cluster

- Collection of redis nodes
  - Able to communicate among themselves.
  - Able to respond to requests collectively.
- Data is automatically sharded across multiple Redis nodes.
- Every redis node require 2 ports:
  - Lower one is used to server clients.
  - Other used for Cluster Bus (node-to-node communication).
- CRC16 hashing system - 16384 hash slots.
- Each cluster node is responsible for a subset of hash slots.
- Hash tags.
- After cluster meet, every node contain node - hash slot mapping.

Resharding

- Redis Cluster supports the ability to add and remove nodes while the cluster is running.
- Same basic mechanism can be used in order to rebalance the cluster, add or remove nodes.
- Moving hash slots through Cluster Bus.
- No down time - with the help of MOVED Error.

Redirection

- Client knows nothing - can send request to any node.
- On recieving a request:
  - return the value if serves that hash slot.
  - MOVED error, if not served.
- MOVED error response also contain IP:PORT of node serving that hash slot.
- Still is an overhead.

Partioning

- The way how we shard data among different nodes of redis cluster.
- **Client side partitioning:** redis clients select the node to which read/write request need to be made.
- **Proxy assisted partitioning:** client sends request to a proxy, which analyzes the request and forwards it to the correct node.
- **Query Routing:** can send request to any node, and the node will forward our request to the desired correct node.
- Examples: Jedis, twemproxy, Redis Cluster.

Twemproxy

- Proxy assisted partitioning implementation.
- It maintains **persistent** server connections.
- Shard data automatically across multiple servers, keeps copy of node configurations.
- Not a single point of failure.
- Stats monitoring port.

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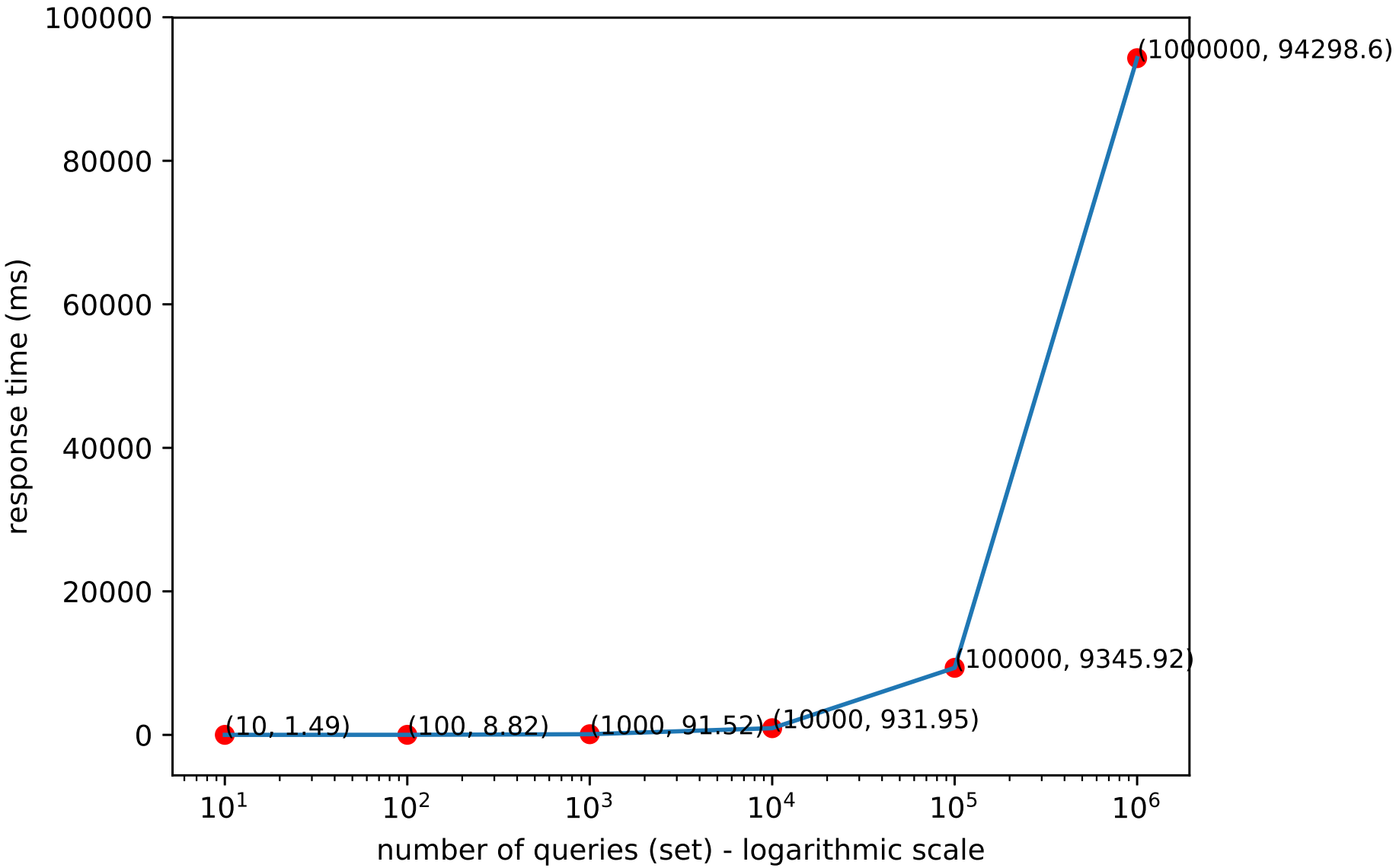
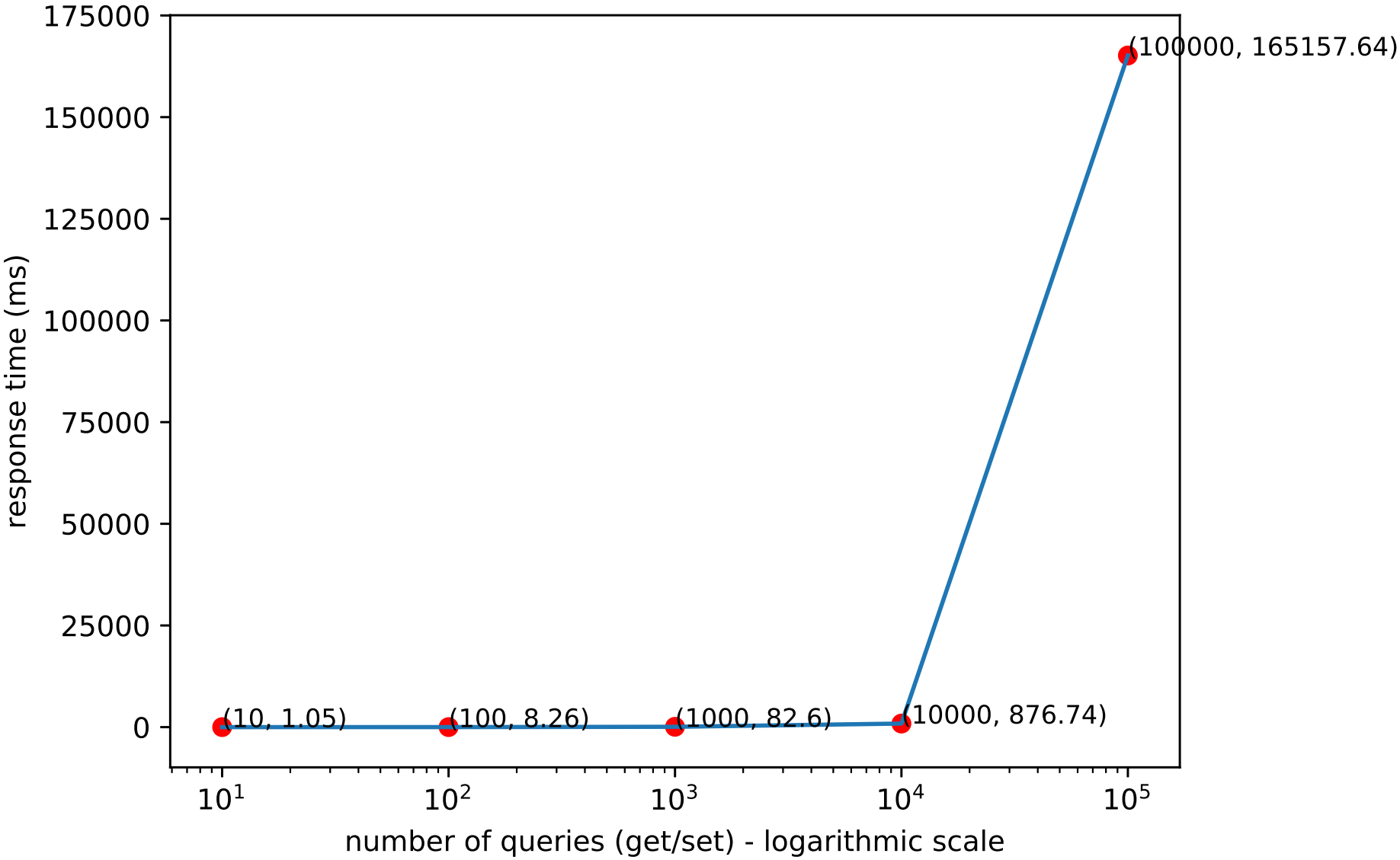
Experiments

- Collecting stats - by limiting resources.
- Generate random strings of length 64 - mimic SHA2.
- Tests based on get/set commands.
- Resource limitation enforced using docker.

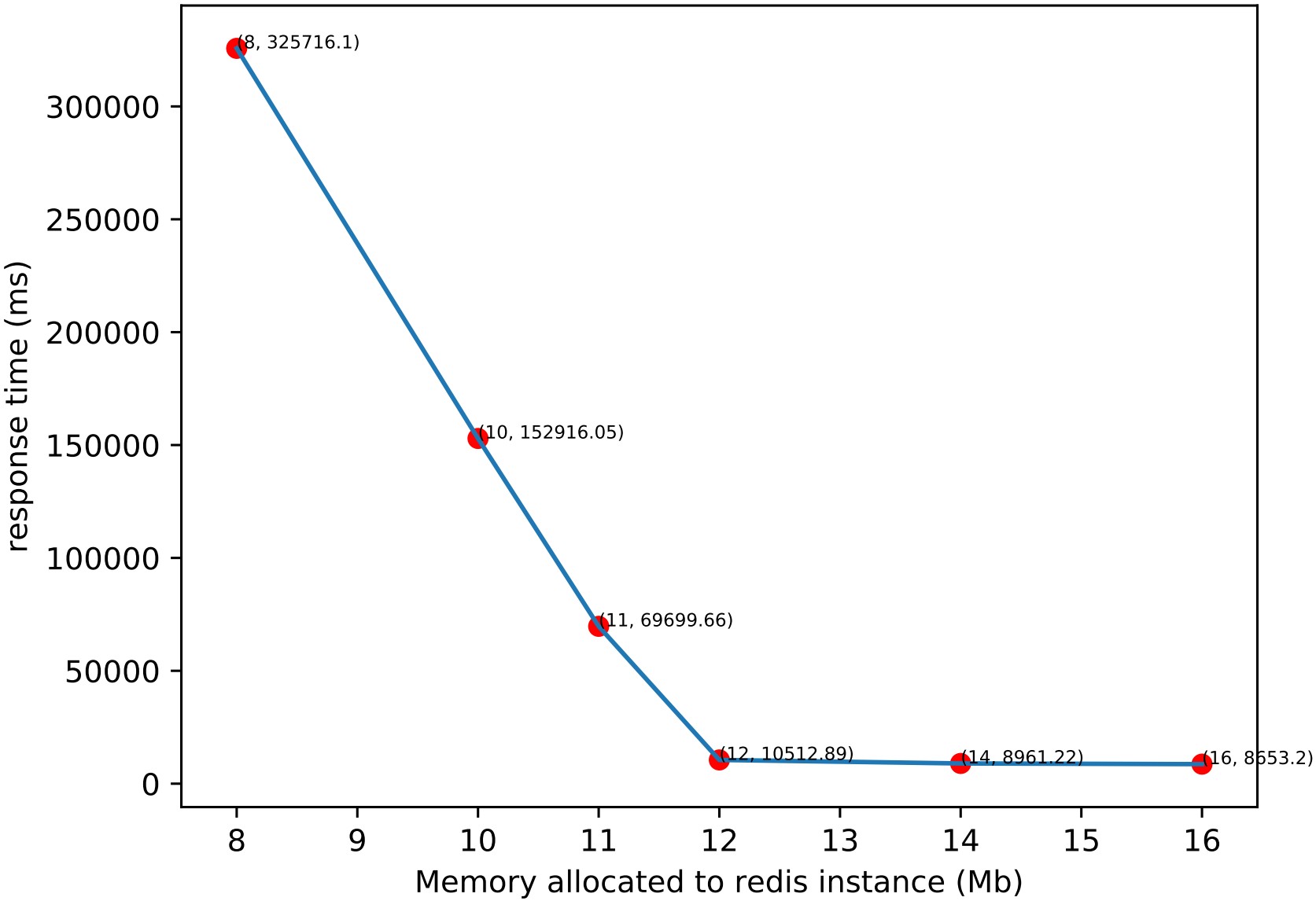
Single redis instance, with no memory/cpu restriction



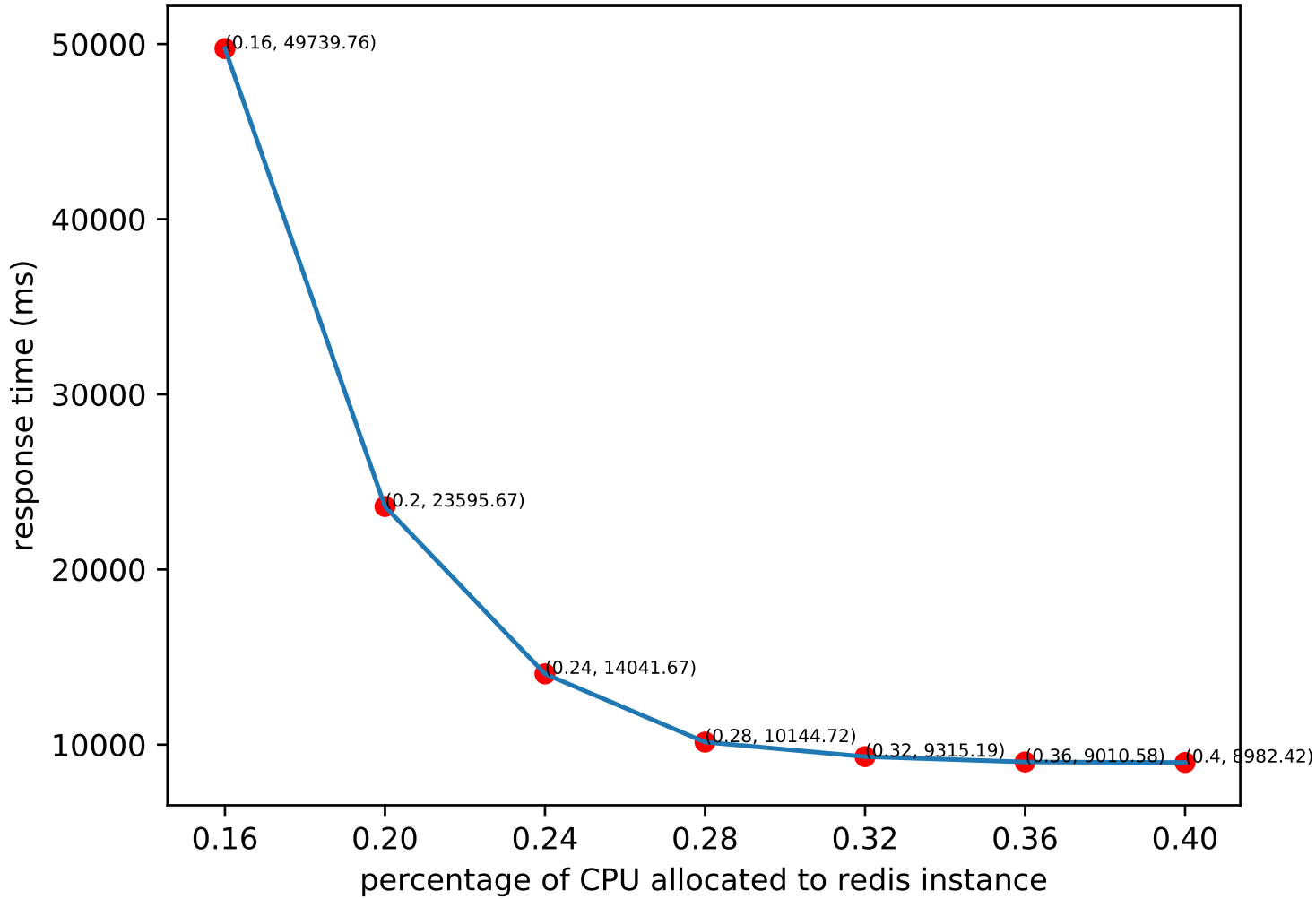
Single redis instance, with max main memory = 10Mb



10^5 queries on redis instance, with varying main memory



10^5 queries on redis instance, with varying CPU



- fractional CPUs?

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hello3

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hello4