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CONVINCE

# sit-aw-anchoring – Hands-on

ROSCon Fr/De W5

18/11/2025

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# Agenda

- Software overview *(architecture, how to adapt for your application domain, how to launch, how to use) [~10+ mins]*

- Run *ready* example *(just run, no modifs) [~10- mins]*

- Add a simple customization *(as time permits) [~10 mins]*

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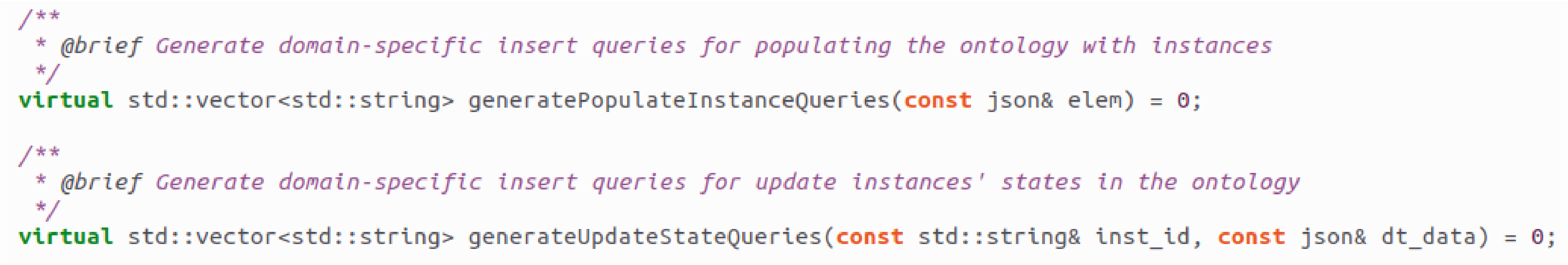
# Architecture

- pkgs organization
  - **`anchoring_process`** — implements the anchoring process; the node to deploy.
  - **`anchoring_process_interfaces, process_msgs`** — interface defs for action servers.
  - **`anchoring_core`** — base plugin for entity managers; the one to specialize for your ontology.
- wait, plugins?
  - custom data process for your specific domain concepts (which data into the KG, how to map data from DT, …)



```
/**
 * @brief Generate domain-specific insert queries for populating the ontology with instances
 */
virtual std::vector<std::string> generatePopulateInstanceQueries(const json& elem) = 0;

/**
 * @brief Generate domain-specific insert queries for update instances' states in the ontology
 */
virtual std::vector<std::string> generateUpdateStateQueries(const std::string& inst_id, const json& dt_data) = 0;
```

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# Plugin Example `anchoring_cubesworld_plugin`

- Plugins are ***THE "thing"*** to implement to use semantic anchoring for your application domain
- Unfamiliar with plugins? https://docs.ros.org/en/rolling/Tutorials/Beginner-Client-Libraries/Pluginlib.html
- **`src/examples/anchoring_cubesworld_plugin/src/anchoring_cubesworld_plugin.cpp`**
  - specializes `anchoring_core::AnchoringManager`
  - weak ptr to parent managed node (for custom operations in configure, activate, cleanup, …)
  - knows about the mapping rules btw DT data and KG concepts data, e.g., `pkg_share_dir+"/rules/mapping"`
  - knows how to manage specificities of concepts' creation in the KG, e.g., cube also need a grasp pose *L108—L123*
- **`src/examples/anchoring_cubesworld_plugin/rules/schemas/`**
  - the schemas that formalize the TQL conceptualization of a domain, e.g., the one we will refer to *"CubesWorld"* (name is free) in the following.

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# Deployment Example: `pick_place_uc`

- **`src/examples/pick_place_uc/launch/cfg/params.yaml`**
  - register *entity managers* — *keys must be the entity names* in your domain *(L4—L6)*
    and, for each manager, the corresponding plugin *(L7—L10)*
  - register knowledge domains — keys are arbitrary *(L11—L12)*
    and, for each domain, a DB name, pkg and paths where schemas are defined *(L13—L19)*
  - set the DB serveraddr *(L3)*

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# ROS Graph

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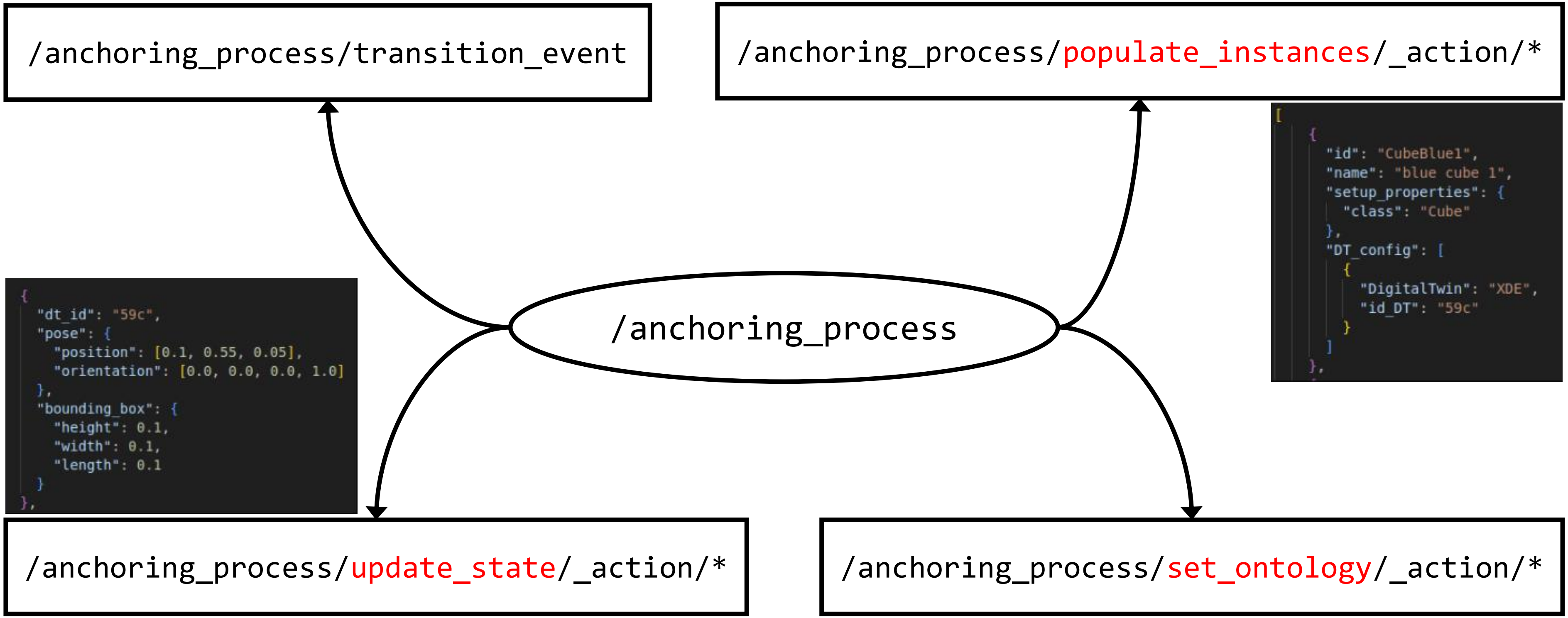

/anchoring_process/transition_event

/anchoring_process/populate_instances/_action/*

/anchoring_process

/anchoring_process/update_state/_action/*

/anchoring_process/set_ontology/_action/*

```
{
  "dt_id": "59c",
  "pose": {
    "position": [0.1, 0.55, 0.05],
    "orientation": [0.0, 0.0, 0.0, 1.0]
  },
  "bounding_box": {
    "height": 0.1,
    "width": 0.1,
    "length": 0.1
  }
},
```

```
[
    {
      "id": "CubeBlue1",
      "name": "blue cube 1",
      "setup_properties": {
        "class": "Cube"
      },
      "DT_config": [
        {
          "DigitalTwin": "XDE",
          "id_DT": "59c"
        }
      ]
    },
```

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# Run the Example (1/5)

- Terminal 1 (start TypeDB server)
  - *Host*
    - *`make start-docker`*
  - *Container*
    - *`typedb server`*

- Terminal 2 (start TypeDB Studio, configure later)
  - Host
    - *`make join-docker`*
  - Container
    - *`typedb-studio`*

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# Run the Example (2/5)

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- Terminal 3 (start DT environment, `setup.json` is already exported)
  - *Host*
    - *make join-docker*
  - *Container*
    - *cd /tmp/dt*
    - *python3 DT_Simulation.py*

- Terminal 4 (prepare to run the simulation)
  - Host
    - *make join-docker*
  - Container
    - *cd /tmp/dt*

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# Run the Example (3/5)

- Terminal 5(*) (launch `pick_place_uc`)
  - *Container*
    - `ros2 launch pick_place_uc pick_place_uc_launch.py`

- Terminal 6 (activate `anchoring_process`)
  - Host
    - `make join-docker`
  - Container
    - `ros2 lifecycle set /anchoring_process configure`
    - `ros2 lifecycle set /anchoring_process activate`

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# Run the Example (4/5) — Setup Phase

- Terminal 6 (cont'd, setup phase for the `anchoring_process`)
  - Container

    -
      ```
      ros2 action send_goal /anchoring_process/set_ontology anchoring_process_interfaces/action/SetOntology "{knowledge_domain: 'CubesWorld'}"
      ```

    -
      ```
      ros2 action send_goal /anchoring_process/populate_instances anchoring_process_interfaces/action/PopulateInstances "{knowledge_domain: 'CubesWorld', instances: '/tmp/dt/setup.json'}"
      ```

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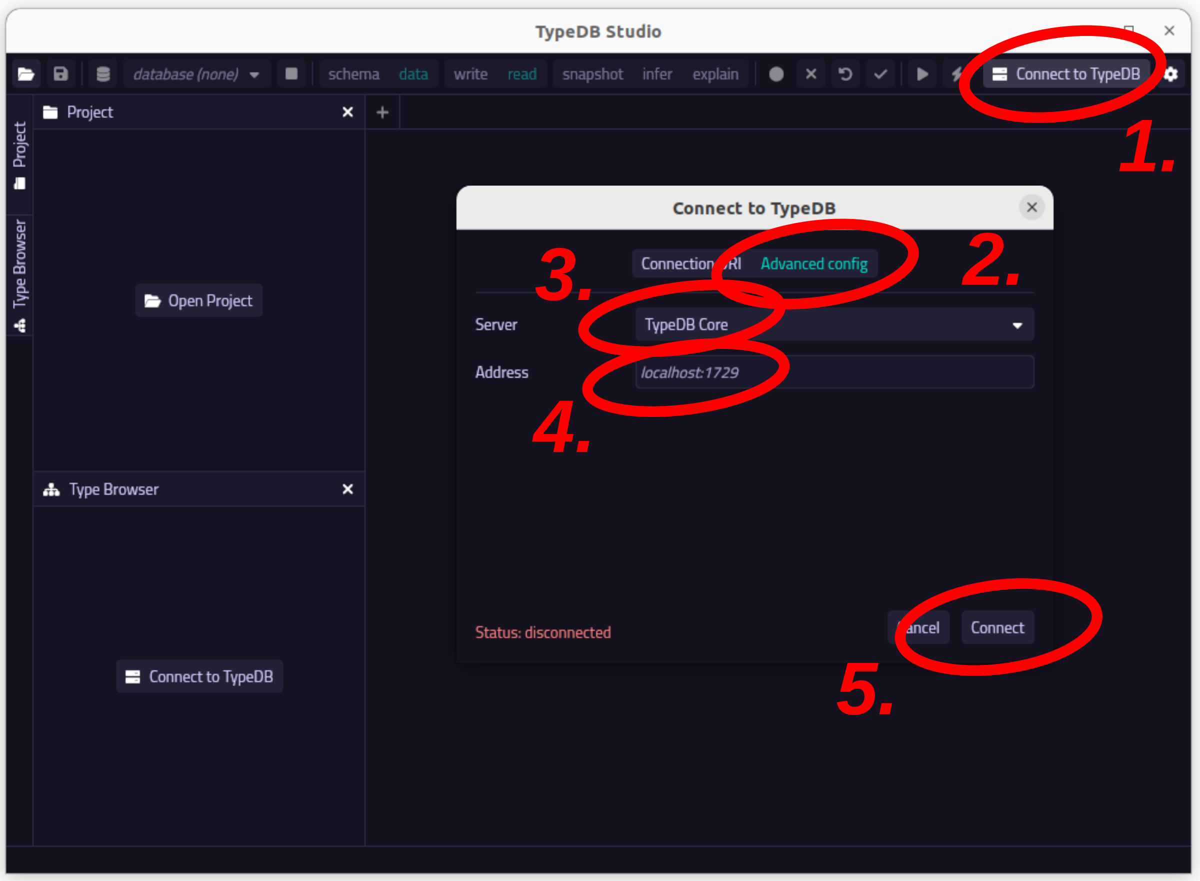
# Configure typedb-studio

- Connect to TypeDB



Server: TypeDB Core

Address: localhost:1729

Status: disconnected

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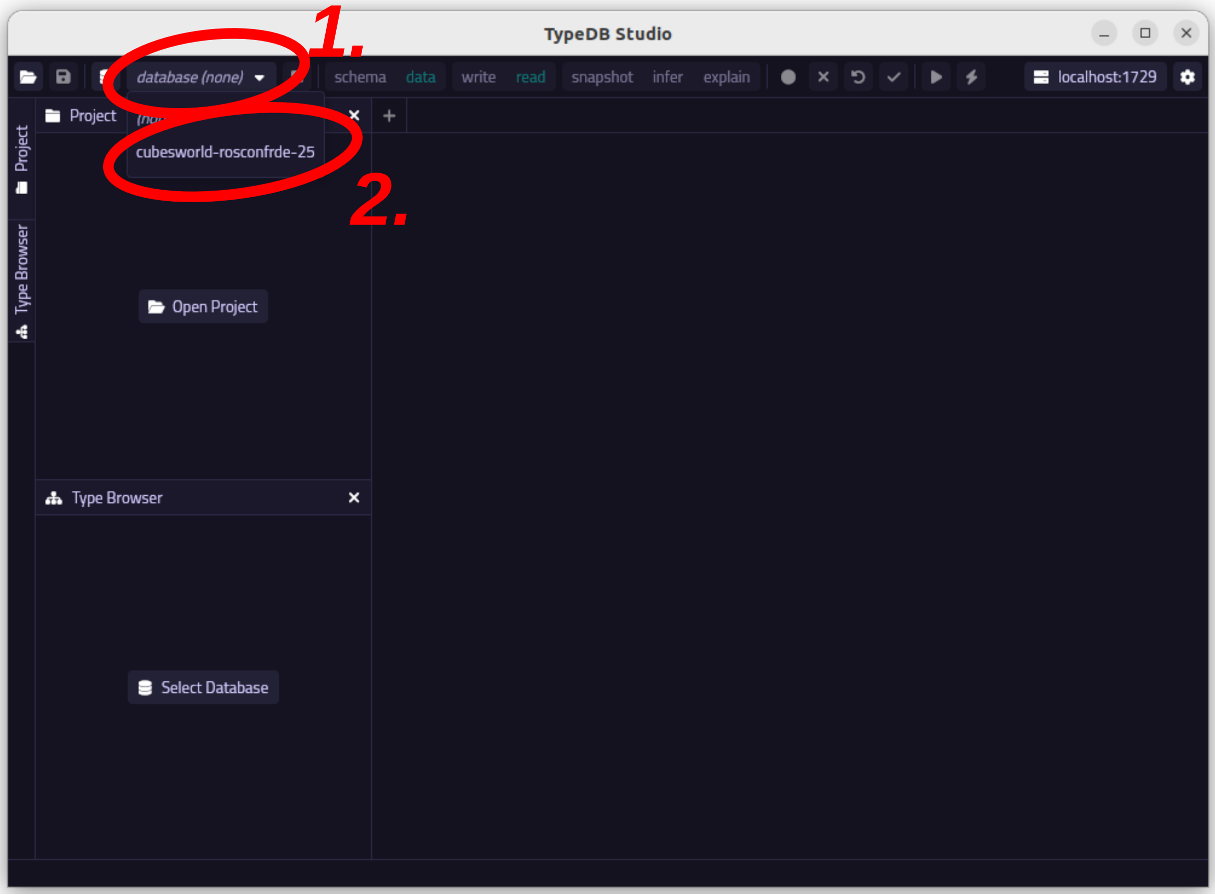
# Configure typedb-studio

- Select database



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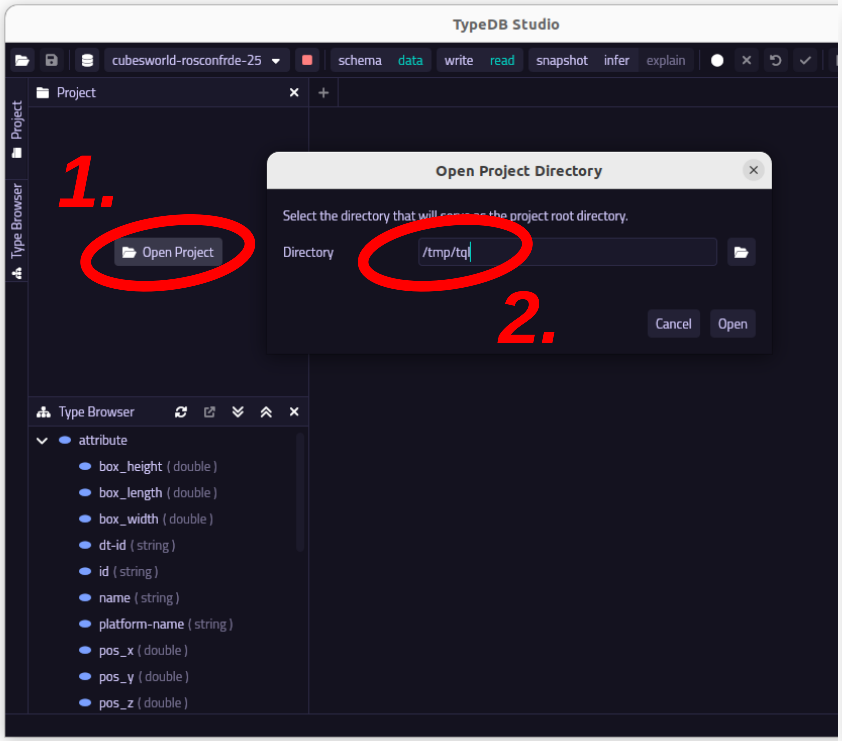
# Configure typedb-studio

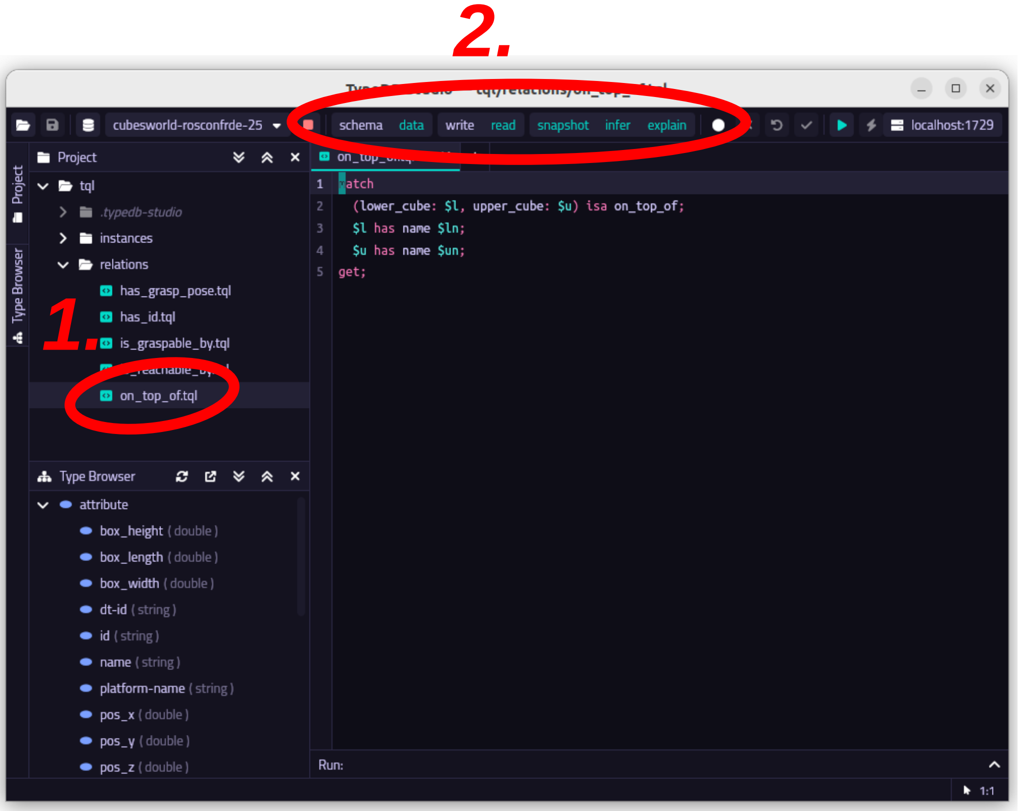
- Open queries



Open Project Directory

Select the directory that will serve as the project root directory.

Directory /tmp/tql



```
match
  (lower_cube: $l, upper_cube: $u) isa on_top_of;
  $l has name $ln;
  $u has name $un;
get;
```

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# Run the Example (5/5) — Execution Phase

- Terminal 4 (cont’d, export DT data at regular intervals)
  - Container

    -
      ```
      python3 update_json.py
      ```

- Terminal 6 (cont’d, execution phase for the `anchoring_process`)
  - Container

    -
      ```
      ros2 action send_goal /anchoring_process/update_state
      anchoring_process_interfaces/action/UpdateState "{knowledge_domain:
      'CubesWorld', instances: '/tmp/dt/runtime.json'}"
      ```

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# Execute `on_top_of` Query in TypeDB Studio

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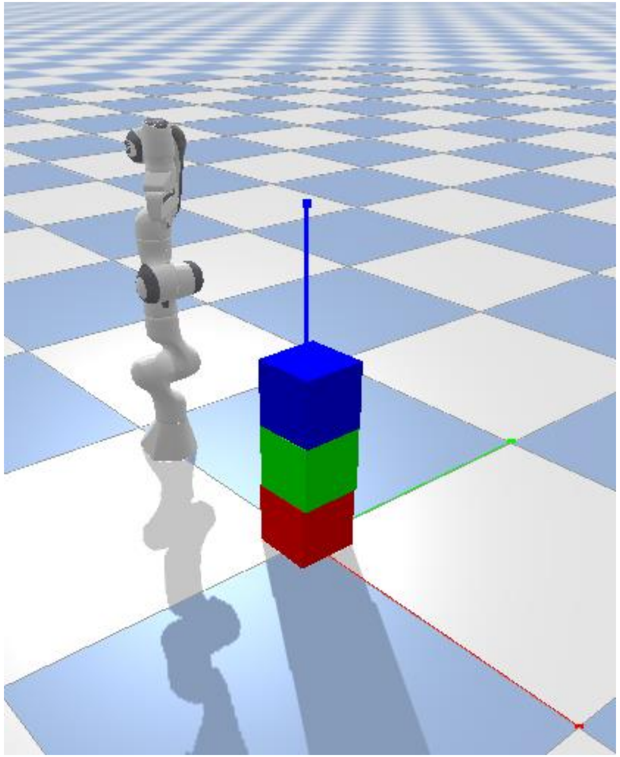

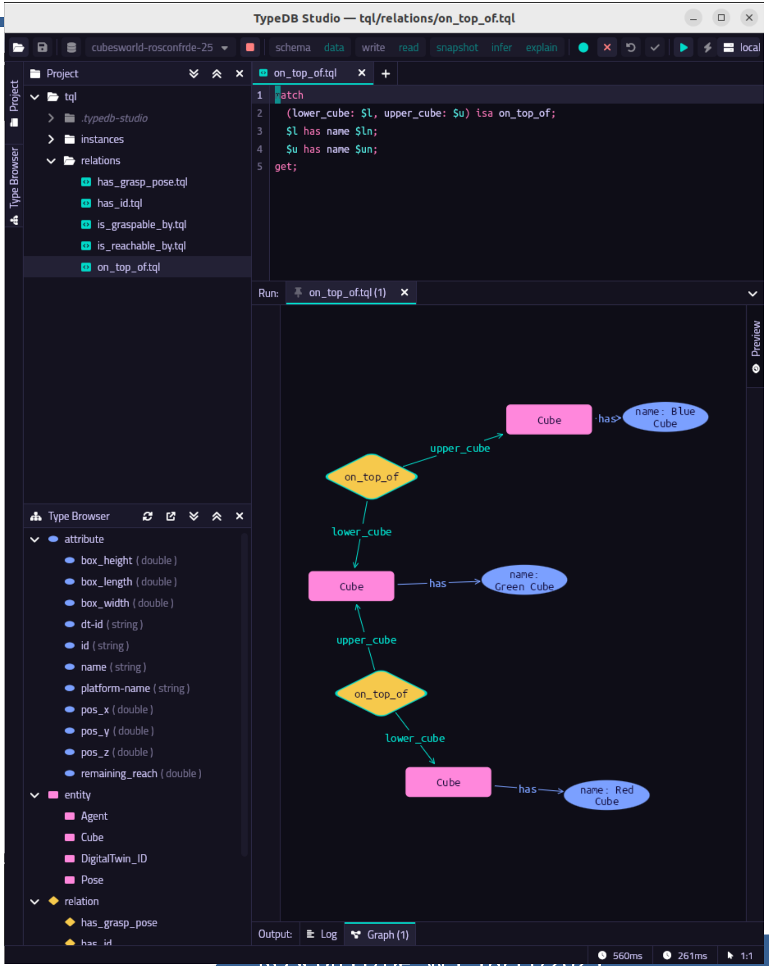

TypeDB Studio — tql/relations/on_top_of.tql

```
match
  (lower_cube: $l, upper_cube: $u) isa on_top_of;
  $l has name $ln;
  $u has name $un;
get;
```

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# Play with the Example

- Cubes and robot have interactive markers and can be moved (not the robot base)

- In Terminal 6, execute the update state action for situations of your choice)
  - Container

    -
      ```
      ros2 action send_goal /anchoring_process/update_state anchoring_process_interfaces/action/UpdateState "{knowledge_domain: 'CubesWorld', instances: '/tmp/dt/runtime.json'}"
      ```

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# Questions?