

CITS3005 IFixIt Knowledge Graph for Game Consoles

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Overview

This is a Flask application to explore and manipulate the game console data from the [MyFixit-Dataset](#). This application consists of multiple parts:

- requirements.txt -====- PIP packages required to run the application
- Game Console.json -====- Original data for game consoles from the MyFixit Dataset
- ontology.py -====- Python script to convert the json data into the ontology.owl file
- ontology.owl -====- XML OWL file storing the IFixit ontology
- swrl.txt -====- SWRL rules used to perform logic on the ontology
- query.py -====- Test script to run SPARQL queries on the ontology
- shapes.ttl -====- SHACL shapes to validate the ontology against
- validate.py -====- Test script to run the SHACL validation against the ontology
- app -====- Flask application contents

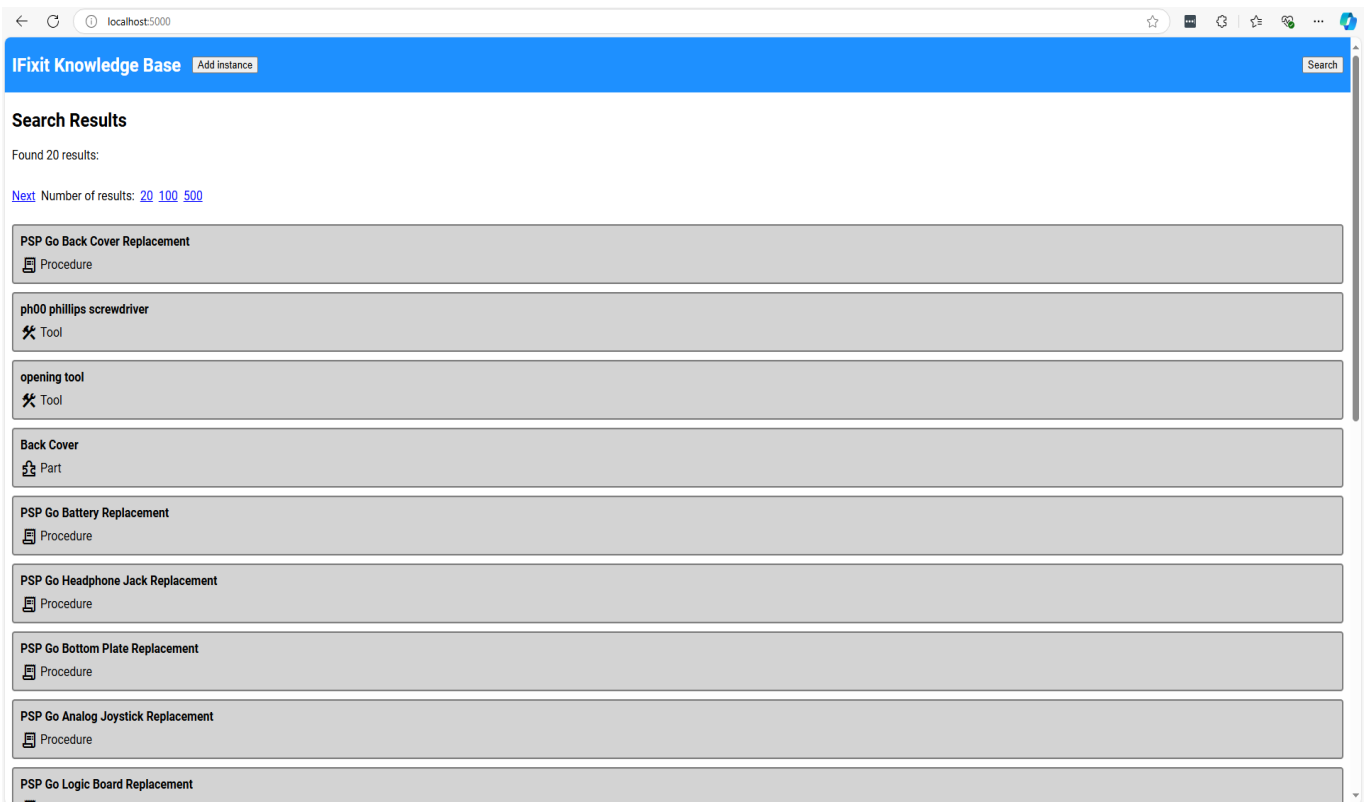
Installation guide

1. Set up your python virtual environment using `python -m venv .venv`.
2. Activate your virtual environment using `source .venv/bin/activate`, or `.venv/Scripts/activate` if you're on Windows.
3. Install the required packages using `pip install -r requirements.txt`.
4. Install java on your system if it's not already so that the reasoner can run. If on Windows, make sure that you're using 64-bit Java, or the reasoner will be unable to load.
5. Run the application by using `cd app && python web_app.py`. This might take a while to start up- the reasoner needs to run over the ontology.
6. You should now be able to access the application by going to <http://localhost:5000>.

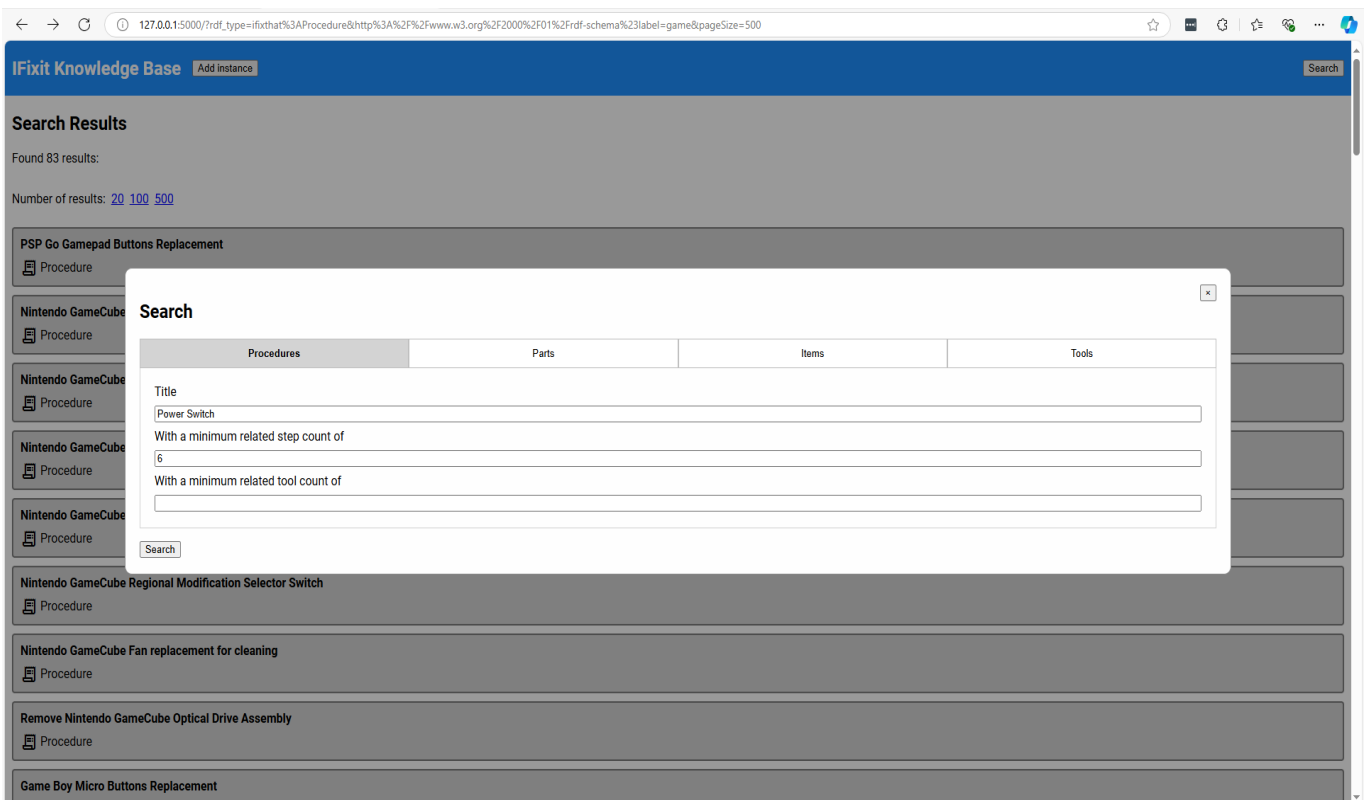
User guide

Searching the knowledge graph

When you open the app, you should see the following page:



This is the search page without any query present- it will just present assorted items. We can refine this by searching. Let's open the form by pressing the top-right 'Search' button.



The search form allows you to search through procedures, parts, items, and tools. Each one has a different form, but for our case we'll only search through procedures. This query searches for:

- Forms that have the term 'Power switch' in their name, and
- Forms that have 6 or more steps

We can see the results below:

127.0.0.1:5000/?rdf_type=ifixthat%3AProcedure&http%3A%2F%2Fwww.w3.org%2F2000%2F01%2Frdf-schema%3Alabel=Power+Switch&stepCount=6&pageSize=500

IFixit Knowledge BaseAdd instanceSearch

Search Results

Found 4 results:

Number of results: 20100500

Nintendo DS Lite Power Switch Replacement

Procedure

PSP 300xc Power Switch Board Replacement

Procedure

Nintendo Game Boy Advance SP Power Switch Cover Replacement

Procedure

Hyperkin Retron 3 Power Switch Replacement

Procedure

Let's click on 'Hyperkin Retron 3 Power Switch Replacement'.

localhost:5000/Procedure/76942

IFixit Knowledge BaseAdd instanceSearch

Errors found:

Type: ValidationResult

Source Constraint Component: MinCountConstraintComponent

Source Shape: nd4c9661e87064afebe228624468061c0b36

Result Severity: Violation

Result Path: http://ifixthat.org/supplierUri

Result Message: Less than 1 values on tool:150->ifixthat:supplierUri

Type: ValidationResult

Source Constraint Component: MinCountConstraintComponent

Source Shape: nd4c9661e87064afebe228624468061c0b36

Result Severity: Violation

Result Path: http://ifixthat.org/supplierUri

Result Message: Less than 1 values on tool:149->ifixthat:supplierUri

Procedure name:

Hyperkin Retron 3 Power Switch Replacement

Steps

Step IDAdd

Step 1

First and foremost, be sure to unplug both power and AV/S-Video cables and remove any games that may be plugged into the console. In order to get into the system you're going to have to remove the 4 rubber boots on the bottom of the console in order to access 4 hidden screws underneath. The other two screws are already accessible. These rubber boots are cheap and not easily reusable if they become stuck to each other or other items. I completely removed mine and because they weren't reattached right away they became stuck to each other and trying to pull them apart causes them to rip. In my case, I'm not particularly concerned if they are there or not and replacements shouldn't be hard to find online I'd imagine. If you'd like to avoid removing the boots utilize the picture provided to simply poke your screw driver threw the boot where the screw would be located. It might be tricky as you're looking for the only circle surrounded by several squares.

When we view our guide, we can see that PyShacl has detected two errors on this page. The errors claim that there is no value for 'supplierUri' on tools 149 and 150.

localhost:5000/Procedure/76942


Hyperkin Retron 3 Power Switch Replacement

Steps

Step ID

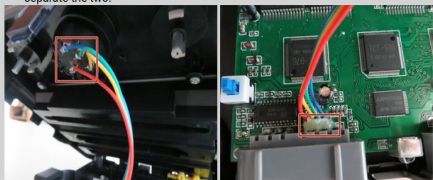
Step 1

First and foremost, be sure to unplug both power and AV/S-Video cables and remove any games that may be plugged into the console. In order to get into the system you're going to have to remove the 4 rubber boots on the bottom of the console in order to access 4 hidden screws underneath. The other two screws are already accessible. These rubber boots are cheap and not easily reusable if they become stuck to each other or other items. I completely removed mine and because they weren't reattached right away they became stuck to each other and trying to pull them apart causes them to rip. In my case, I'm not particularly concerned if they are there or not and replacements shouldn't be hard to find online I'd imagine. If you'd like to avoid removing the boots utilize the picture provided to simply poke your screw driver threw the boot where the screw would be located. It might be tricky as you're looking for the only circle surrounded by several squares.



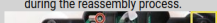
Step 2

DO NOT ATTEMPT TO COMPLETELY SEPARATE THE TWO HALVES AS THEY ARE CONNECTED VIA THE SYSTEM SWITCH DIAL ON THE UPPER SHELL AND THE MAIN PCB. The cables have been glued down at the connection points as well. The upper shell and PCB unit don't need to be completely separated in order to get in and repair the system although it would make it easier. Unless you are confident in removing this glue without causing damage and your soldering skills I don't advise trying to separate the two.



Step 3

I find it easiest to prop up the top shell on the front right corner of the system. If you're using a flat surface it can stand by itself and there's enough slack in the Genesis PCB and Dial Switch cables to allow it to be positioned in such a way. You can barely see it but the upper shell is standing upright on the front right corner. There are 11 screws that need to be removed in order to remove the entire PCB unit. If the IR lens cover pops out at this point don't worry about it. It can be easily reinstalled during the reassembly process.




As we scroll down we can see steps that the procedure contains with their images.

127.0.0.1:5000/Procedure/76942

For parts

Part ID

Power Switch

 Part


For items

Item ID


Requires tools

Tool ID


soldering gun

 Tool


iron

 Tool


solder

 Tool


solder braid

 Tool


desoldering pump

 Tool

esd bracelet

 Tool

phillips screwdriver

 Tool

After the steps, we can see what parts, items, and tools this procedure is for. This procedure operates on the 'Power Switch' part (presumably for the Hyperkin Retron 3). We can click on that block to navigate to the part, but we won't do that for now. Instead we can hover the tools to reveal the hovered link (see in bottom left corner) to discover that 'soldering gun' and 'iron' are tools 149 and 150!

Editing instances in the knowledge graph

Let's click on the soldering gun tool to go to it's page:

The screenshot shows a web browser at localhost:5000/Tool/149. The page header is 'iFixit Knowledge Base' with an 'Add instance' button and a search bar. The main content area has a red box for 'Errors found:' with the following text: 'Type: ValidationResult', 'Source Constraint Component: MinCountConstraintComponent', 'Source Shape: nea00a70c438541b6b6c078ff08575508b36', 'Result Severity: Violation', 'Result Path: http://ifxthat.org/supplierUri', and 'Result Message: Less than 1 values on tool:149->ifxthat:supplierUri'. Below the error box, the 'Tool name:' field contains 'soldering gun'. The 'Supplier URL:' field is empty. There are sections for 'Images' (with an 'Add' button) and 'Required for procedures' (with a table of three items: 'Nintendo 3DS Charger port Replacement', 'Hyperkin Retron 3 Power Switch Replacement', and 'Super Nintendo 50/60 Hz Switchless Mod + LED Mod', each with a 'Delete' button).

We can see the error is reiterated here, and indeed the supplier URL is empty. Let's adjust it to a URL of our choosing.

This screenshot shows the same interface as the previous one, but the 'Supplier URL:' field now contains 'http://www.google.com'. The error message in the red box remains the same, indicating that the validation error persists despite the change. The rest of the interface, including the 'Errors found:' section and the 'Required for procedures' table, is identical to the previous screenshot.

Reloading the page will verify that the changes have persisted. The error will remain until we restart the application- performing a SHACL validation every API query is not feasible for us.

Deleting instances in the knowledge graph

Let's navigate back to our procedure page and deal with the other invalid tool a different way.

127.0.0.1:5000/Procedure/76942

For parts

Part ID

Add

Power Switch

Part

Delete

For items

Item ID

Add

Requires tools

Tool ID

Add

soldering gun

Tool

Delete

iron

Tool

Delete

solder

Tool

Delete

solder braid

Tool

Delete

desoldering pump

Tool

Delete

esd bracelet

Tool

Delete

phillips screwdriver


Tool

Delete

Hit the 'delete' button to remove the link to the 'iron' tool.

127.0.0.1:5000/Procedure/76942


A^{*} ☆ 🖨 ⚙ 🔍 ☰ ...



For parts

Part ID Add

Power Switch

 Part

Delete


For items

Item ID Add

Requires tools


Tool ID Add

soldering gun

 Tool


Delete

solder

 Tool


Delete

solder braid

 Tool


Delete

desoldering pump

 Tool


Delete

esd bracelet

 Tool

Delete

phillips screwdriver

 Tool

Delete

If we restart the application, we can now see that all validation has passed for this procedure!



Let's add a new tool to the first step of our procedure. To add a tool, we'll need the id of the tool we're adding. To get the id, we look at the url on a tool view page. We'll add an 'opening tool' as a required tool for the first step of this procedure.

localhost:5000/Tool/2

IFixit Knowledge Base
Add Instance
Search

No errors found

Tool name:
opening tool

Supplier URL:
https://www.ifixit.com/Store/Parts/IFixit-Opening-Tool/IF145-335

Images
 Add

Required for procedures
 Add

PSP Go Back Cover Replacement
Procedure
Delete

PSP Go Battery Replacement
Procedure
Delete

PSP Go Headphone Jack Replacement
Procedure
Delete

PSP Go Bottom Plate Replacement
Procedure
Delete

PSP Go Analog Joystick Replacement
Procedure
Delete

Click on the 'Step 1' link to go to the step, type in the tool id (2) and press 'Add' to add the tool to the step.

localhost:5000/Step/153798

No errors found

Step actions:
First and foremost, be sure to unplug both power and AV/S-Video cables and remove any games that may be plugged into the console. In order to get into the system you're going to have to remove the 4 rubber boots on the bottom of the console in order to access 4 hidden screws underneath. The other two screws are already accessible. These rubber boots are cheap and not easily reusable if they become stuck to each other or other items. I completely removed mine and because they weren't reattached right away they became stuck to each other and trying to pull them apart causes them to rip. In my case, I'm not particularly concerned if they are there or not and replacements shouldn't be hard to find online I'd imagine. If you'd like to avoid removing the boots utilize the picture provided to simply poke your screw driver threw the boot where the screw would be located. It might be tricky as you're looking for the only circle surrounded by several squares.

Images
 Add


Delete

Uses tools
 Add

phillips screwdriver
Tool
Delete

opening tool
Tool
Delete

Part of procedures
 Add

Hyperkin Retron 3 Disassembly
Procedure
Delete

After we restart the application, we can also see SWRL has inferred that this tool is required for the procedure as well.

For parts

Part ID

Power Switch
Part

For items

Item ID

Requires tools

Tool ID

soldering gun
Tool

solder
Tool

solder braid
Tool

desoldering pump
Tool

esd bracelet
Tool

opening tool
Tool

phillips screwdriver
Tool

Instances can also be added by pressing the 'Add instance' button on the navigation header. This will open a model which will allow you to create a new instance unconnected to anything else in the knowledge graph.

Modifying the ontology

To add new rules to the ontology, add the rule in Conjunctive Normal Form to the `swrl.txt` file on a single line. The rule will be applied to the reasoner on the next start of the Flask application.

Ontology structure

Overview

The following is the structure of the schemas for each entity in the ontology, as well as some examples for each class and property. Each concept has a namespace associated with it.

Concept	Description
Procedure	A set of steps that describe how to repair or assemble a specific item. Procedures involve tools, parts, and sometimes Images to guide the user.
Item	The primary appliance being repaired or assembled. Items can have parts and sub-items.
Part	A component of an item that may need to be replaced or repaired.
Tool	An instrument used in a procedure to perform a task. Procedures need tools for certain steps.
Step	An individual action in a procedure that describes how to perform part of the task.

Concept	Description
Image	Visual documentation associated with a Tool, or possibly to clarify steps within a procedure.

Procedure schema

RDF property	Description	Example value
PROCEDURE:<id>	URI representing the Procedure.	PROCEDURE#12811
RDF.type	Concept type (always Procedure here)	IFIXTHAT.Procedure
RDFS:label	The name of the procedure	"New Nintendo 2DS XL Front Buttons Replacement"
IFIXTHAT:subProcedureOf	A Procedure for which this Procedure's steps are a subset of	PROCEDURE#62492
IFIXTHAT:requiresTool	A Tool that is needed to complete the Steps of a Procedure	TOOL:Phillips_00_Screwdriver
IFIXTHAT:guideOf	An Item / Part this Procedure is written for	PART:New_Nintendo_2DS_XL_Front_Buttons
IFIXTHAT:hasStep	A Step, with their order in this Procedure's list of Steps	IFIXTHAT#orderedstep5962

In order to store Steps in an ordered list, an intermediate class was also created, called OrderedStep. It has the Schema:

RDF property	Description	Example value
IFIXTHAT#<id>	URI representing the OrderedStep	IFIXTHAT#orderedstep2
RDF.type	Concept type (always OrderedStep here)	IFIXTHAT.OrderedStep
IFIXTHAT:details	The Step linked to the order	STEP#6309
IFIXTHAT:order	The index of the step in the corresponding Procedure's list of steps	1

Item schema

RDF property	Description	Example value
ITEM#<id>	URI representing the Item	ITEM#57

RDF property	Description	Example value
RDF:type	Concept type (always Item here)	IFIXTHAT.Item
RDFS:label	The name of the Item	"Nintendo WaveBird Wireless Controller"
IFIXTHAT:subCategoryOf	An Item which is a superclass of this Item	ITEM#51

Part schema

RDF property	Description	Example value
PART#<id>	URI representing the Part	PART#355
RDF:type	Concept type (always Part here)	IFIXTHAT.Part
RDFS:label	The name of the Part	"Buttons"
IFIXTHAT:partOf	An Item for which this Part is a part of	ITEM#57

Tool schema

RDF property	Description	Example value
TOOL#<id>	URI representing the Tool	TOOL#95
RDF:type	Concept type (always Tool here)	IFIXTHAT.Tool
RDFS:label	The name of the Tool	"essential electronics toolkit"
IFIXTHAT:hasImage	An Image of this Tool	IMAGE#2897
IFIXTHAT:supplierUrl	The url for which this Tool can be found / bought	"https://www.ifixit.com/Store/Tools/Essential-Electronics-Toolkit/IF145-348"

Step schema

RDF property	Description	Example value
STEP#<id>	URI representing the Step	STEP#58074
RDF:type	Concept type (always Step here)	IFIXTHAT.Step
IFIXTHAT:hasImage	An Image corresponding to this Step	IMAGE#2902

RDF property	Description	Example value
IFIXTHAT:usesTool	A tool that needs to be used in this Step	TOOL#2
IFIXTHAT:actions	The description of actions that need to be carried out for this Step	"Wedge a plastic opening tool into the case-splittings and pull down to crack open the casing near the following buttons: ""Share"" button ""Options"" button Split the plastic covers of the controller apart, taking note that they will still be attached by circuit board ribbons. Three small pieces are often released from the framework. To prevent loss, maintain a controlled work field. 2 Trigger Springs 1 Grey Reset Button Extension"

Image schema

RDF property	Description	Example value
IMAGE#<id>	URI representing the Image	Image#2904
RDF.type	Concept type (always Image here)	IFIXTHAT.Image
IFIXTHAT.dataURL	The URL location of the Image on the internet	"https://d3nevzfk7ii3be.cloudfront.net/igi/NnxoILTrI2FnxDa.standard"

Building the ontology

To build the ontology from the `Game Console.json` data (sourced from MyFixit), run `python ontology.py`. This will generate the `ontology.owl` file.

Validating the ontology

To validate the ontology, run `python validate.py`. There will be some errors that show up with required supplier URLs- this is so we can demonstrate the website error detection system.

Running test queries

To run test queries, run `python query.py`.