Διακυβέρνηση δεδομένων και αυτοματοποιημένη συμμόρφωση σε ροές εργασίας

Γιώργος Λιουδάκης

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Αρχή Προστασίας Δεδομένων – 2η Ημέρα Διαλόγου με την Ερευνητική Κοινότητα

22 Οκτωβρίου 2026

Data sharing and processing across organisational boundaries

- Data support informed decision-making, scientific research and the development of new services.
- Combining internal data with external and complementary datasets enables more comprehensive analyses and new applications.
- Data spaces support access, sharing and reuse across organisations through interoperable infrastructures and agreed governance frameworks.
- Workflows describe how processing activities, actors and systems interact, providing a structured basis for organising data use.
- These activities may span multiple systems and organisations, involving different responsibilities and conditions/constraints of data use.
- Data governance needs to address both the access constraints and the way data are subsequently processed.

Data governance challenges

- Organisations need clear roles and responsibilities for managing data and deciding how they may be accessed, shared and used.
- The use of data is subject to regulatory requirements, organisational policies and data providers' constraints, which may differ across datasets and contexts.
- These requirements govern who may use which data, for what purposes and under which conditions, including restrictions on location, retention and further sharing.
- Collaboration requires a shared understanding of data and applicable rules, together with mechanisms for identifying and addressing conflicting requirements.
- Supporting accountability requires traceability and evidence of data use, allowing organisations to assess whether the applicable conditions have been respected.

Applying data governance in workflows

- Governance rules must be incorporated into processing tasks and data flows.
- Requirements may determine the order of operations, their implementation, the inclusion of additional safeguards or the exclusion of certain types of processing.
- The intended workflow needs to be checked against governance rules to identify conflicts, missing safeguards and required adaptations.
- Changes to policies or workflows require renewed checks, while records of actual processing support subsequent assessment and accountability.
- Executable pipelines derived from workflow models should reflect data governance requirements.
- Organisations need simple ways to design, verify and adapt workflows in line with applicable governance requirements.

goodFlows

Engineering compliance by design

Access and usage control ● Workflow engineering ●

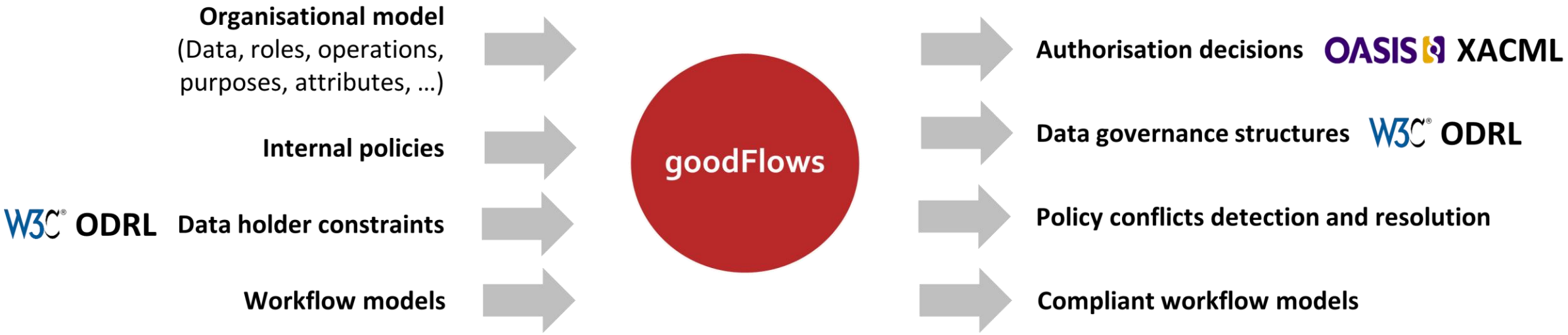
Semantic modelling ● Compliance by design ● One environment





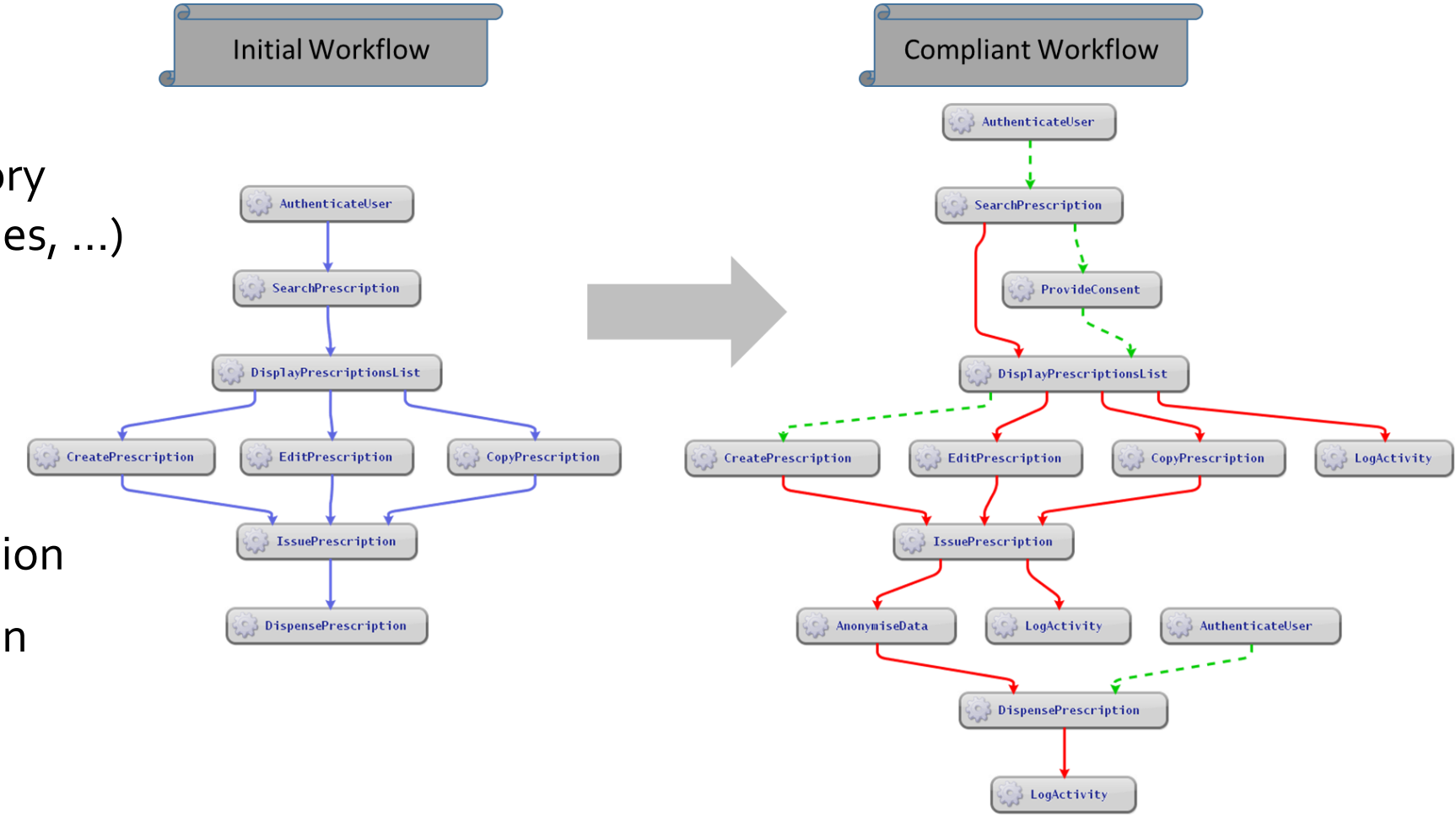
goodFlows

goodFlows is a policy-driven platform for **compliance by design**, combining **semantic modelling**, **access and usage control** and **workflow engineering**, to help organisations design, verify and re-engineer compliant business processes and data pipelines. It allows **data governance** in distributed environments, supports **IDSA negotiations** providing comprehensive **conflict resolution**, and turns compliance requirements into practical, **executable workflows**.



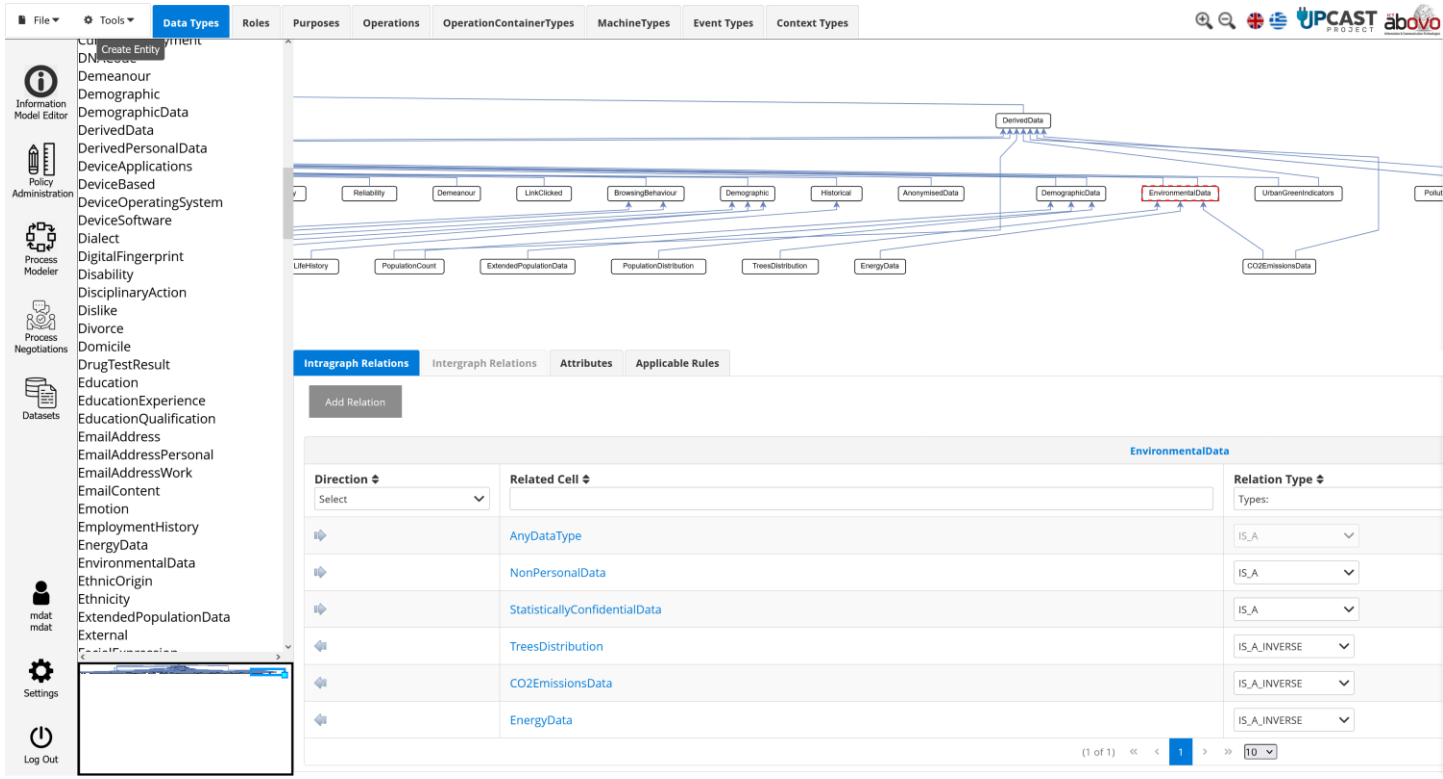
Towards compliance by design: Automatic workflow verification and re-engineering

- Business processes and data processing pipelines
- Based on internal (regulatory provisions, corporate policies, …) and third-party rules (e.g., data holders in data marketplaces)
- Comprehensive and explainable conflict resolution
- IDSA-compliant negotiation among involved parties



goodFlows features

- Semantic modelling, with inherent DPV/ODRL alignment, and functionality for import/alignment from any ontology
- Attribute-based access and usage control, with built-in policy management and decision-making (PAP/PDP)
- Visual workflow modelling and dataset management for Data Processing Workflows
- Verification, re-engineering, explainable conflict resolution and negotiation against internal & third-party rules
- Translation of workflow models into executable Nextflow scripts
- Expandable, to integrate additional features



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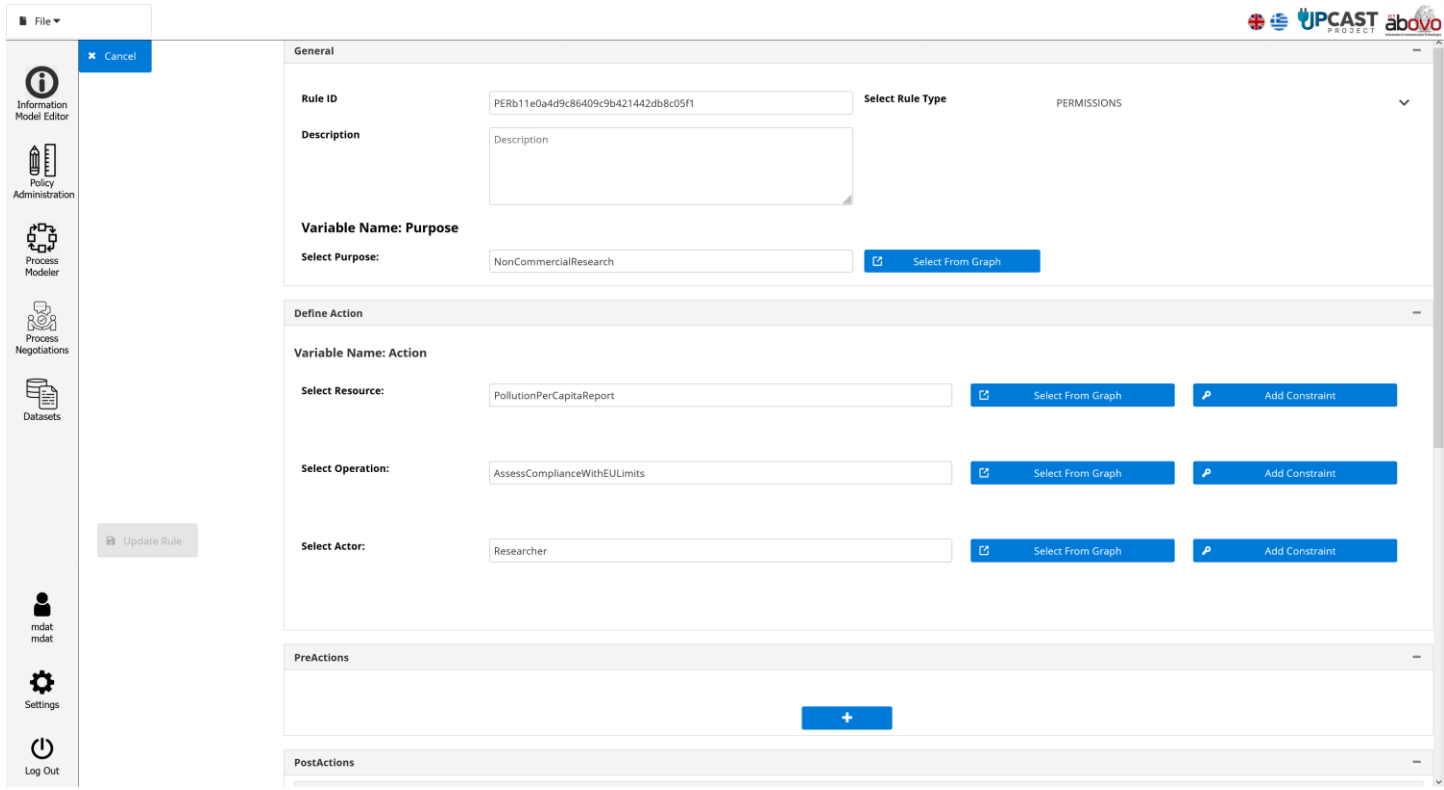

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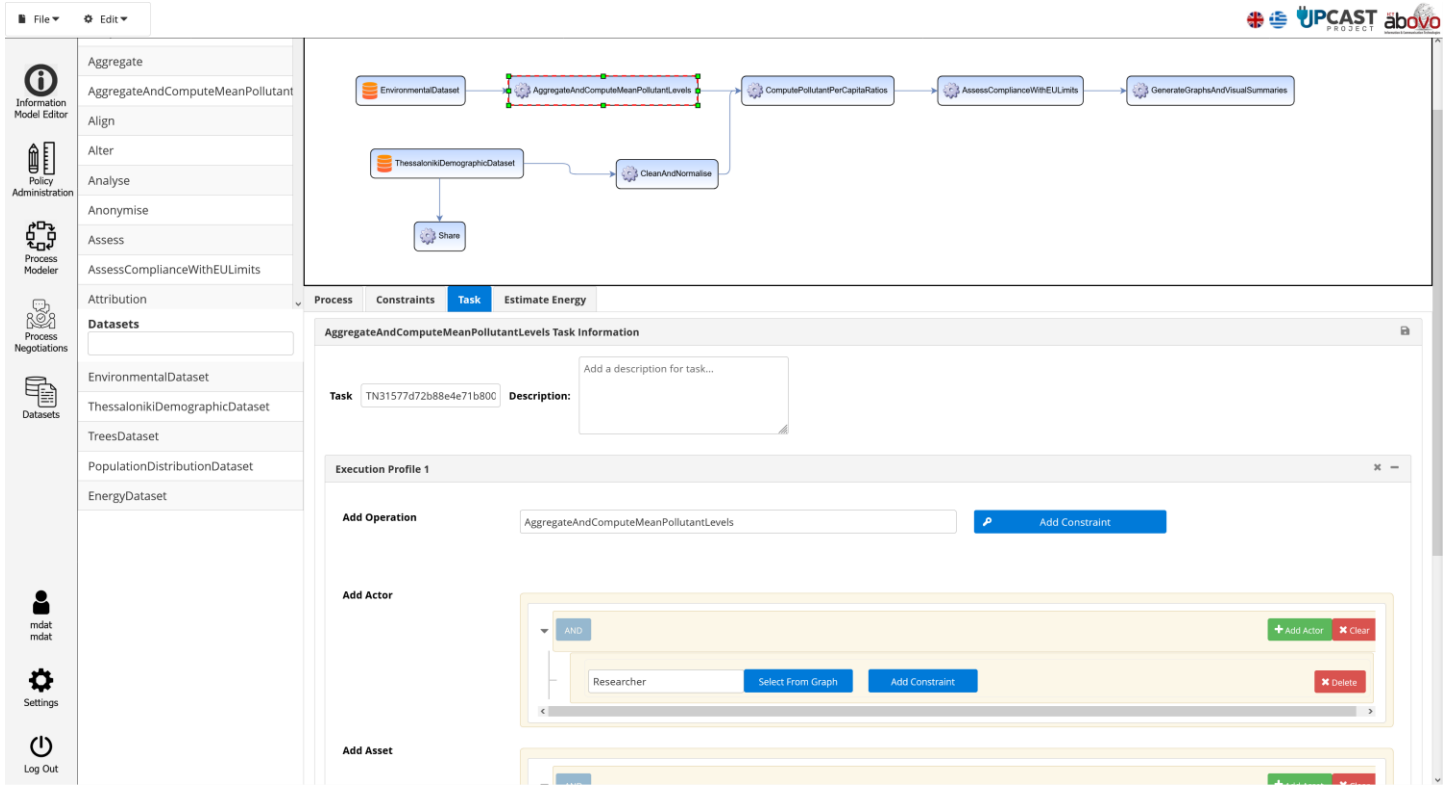

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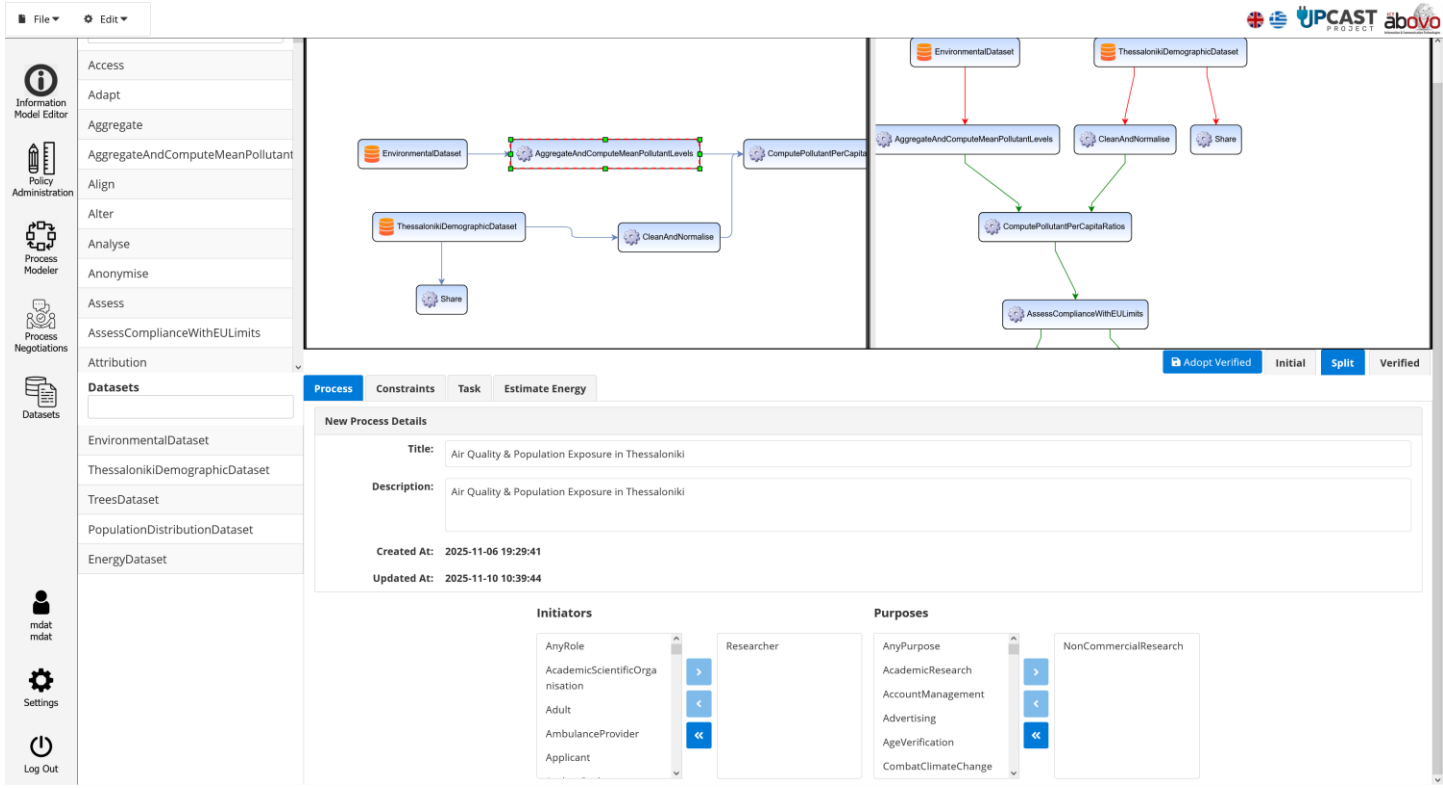

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```
473
474   else if (report.contains("Error executing process")) { // process failure
475     String cmdExit = getCommandExitStatus(workflow.errorReport)
476     String processName = getProcessName(workflow.errorReport)
477     println "Process '$processName' failed with exit code $cmdExit"
478     errorDetails = "Process '$processName' failed with exit code $cmdExit"
479
480     sendKafkaMessage([
481       metric: 'action-stop',
482       value : processName,
483       result: cmdExit,
484       source: processName,
485       exception: 'Operation ' + processName + ' failed with error code: ' + cmdExit,
486       log: 'Operation ' + processName + ' failed with error code: ' + cmdExit
487     ])
488
489   }
490
491   else { // unclassified error
492     println "Unclassified error: $report"
493     errorDetails = "Unclassified error: $report"
494   }
495 }
496
497 workflow.onComplete {
498   if(workflow.success)
499   {
500     println "Workflow completed successfully!"
501     sendKafkaMessage([
502       metric: 'stop',
503       value : 'wf',
504       result: 'none',
505       exception: 'none',
506       log   : 'Workflow with contract number ' + this.contractNumber + ' and name ' + this.workflowName + ' completed execution'
507     ])
508   }
509   else
510   {
511     println "Workflow failed; errorDetails: " + errorDetails
512     sendKafkaMessage([
513       metric: 'stop',
514       value : 'wf',
515       result: 'none',
516       exception: errorDetails,
517       log   : 'Workflow with contract number ' + this.contractNumber + ' and name ' + this.workflowName + ' completed execution with errors'
518     ])
519   }
520 }
521
522
523
524 workflow {
525
526   def EnvironmentalDatasetChannel = Channel.fromPath(params.EnvironmentalDataset, checkIfExists: true)
527   def ThessalonikiDemographicDatasetChannel = Channel.fromPath(params.ThessalonikiDemographicDataset, checkIfExists: true)
528   def AggregateAndComputeMeanPollutantLevelsOutput = AggregateAndComputeMeanPollutantLevels(EnvironmentalDatasetChannel)
529   def CleanAndNormaliseOutput = CleanAndNormalise(ThessalonikiDemographicDatasetChannel)
530   def ComputePollutantPerCapitaRatiosOutput = ComputePollutantPerCapitaRatios(AggregateAndComputeMeanPollutantLevelsOutput, CleanAndNormaliseOutput)
531   def DeleteOutput = Delete(ComputePollutantPerCapitaRatiosOutput)
532   def AssessComplianceWithEULimitsOutput = AssessComplianceWithEULimits(ComputePollutantPerCapitaRatiosOutput)
533   def StoreOutput = Store(AssessComplianceWithEULimitsOutput)
534   def GenerateGraphsAndVisualSummariesOutput = GenerateGraphsAndVisualSummaries(AssessComplianceWithEULimitsOutput)
535
536 }
```

nextflow

goodFlows features

- Semantic modelling, with inherent DPV/ODRL alignment, and functionality for import/alignment from any ontology
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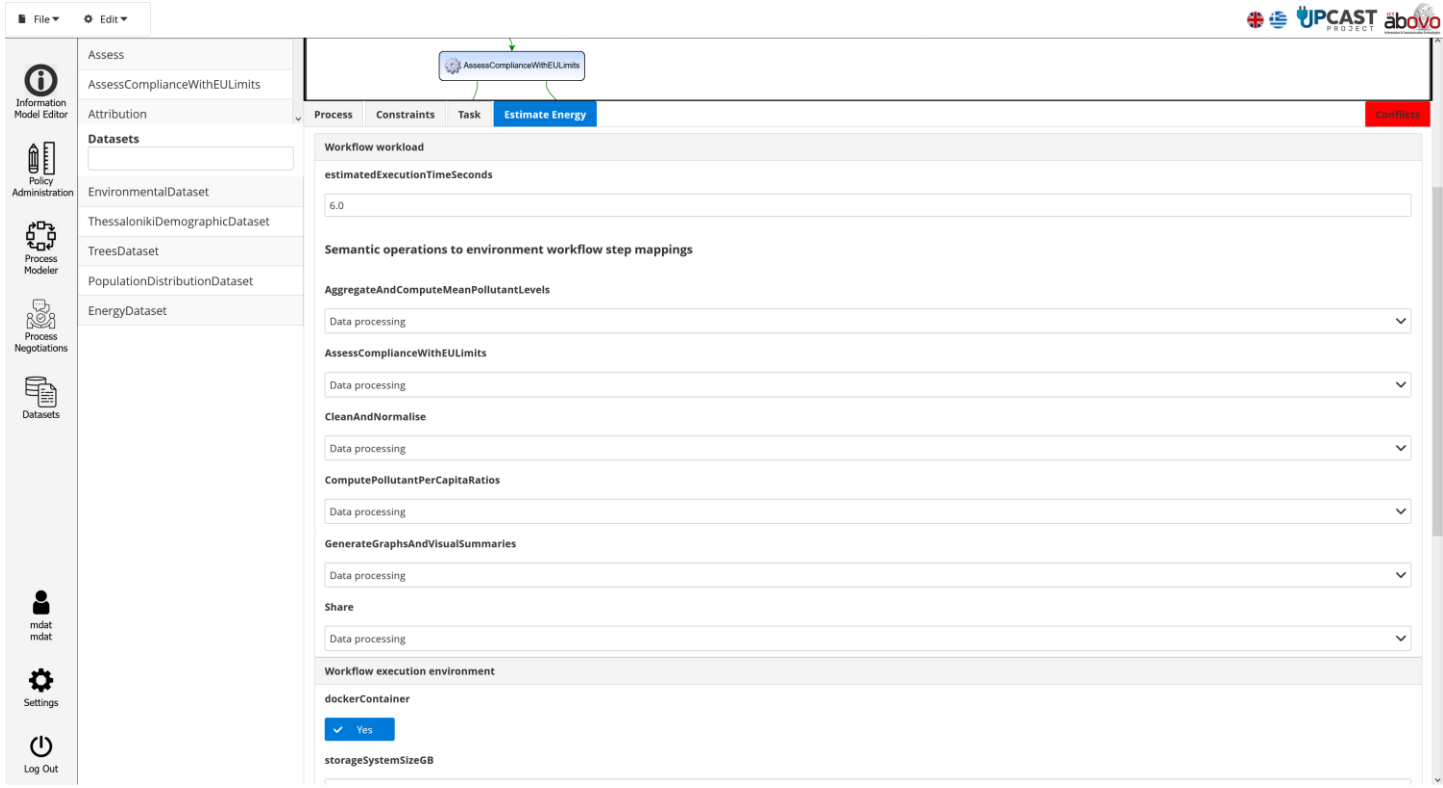


Successful use cases

- **Cooperative and privacy preserving network monitoring**: automated verification and deployment of threat detection and mitigation workflows
- **E-government**: automated governance control of business processes in the public insurance sector and data subject rights enforcement
- **Public administration**: legal basis and retention management in urban (environmental & demographic) data processing
- **Bioinformatics**: compliant data sharing and processing in the areas of cancer genomics and in-vitro gene expression

Example: genomics workflow

Co-funded by the European Union

UPCAST PROJECT

ΕΘΝΙΚΟ ΙΔΡΥΜΑ ΕΡΕΥΝΩΝ
National Hellenic Research Foundation

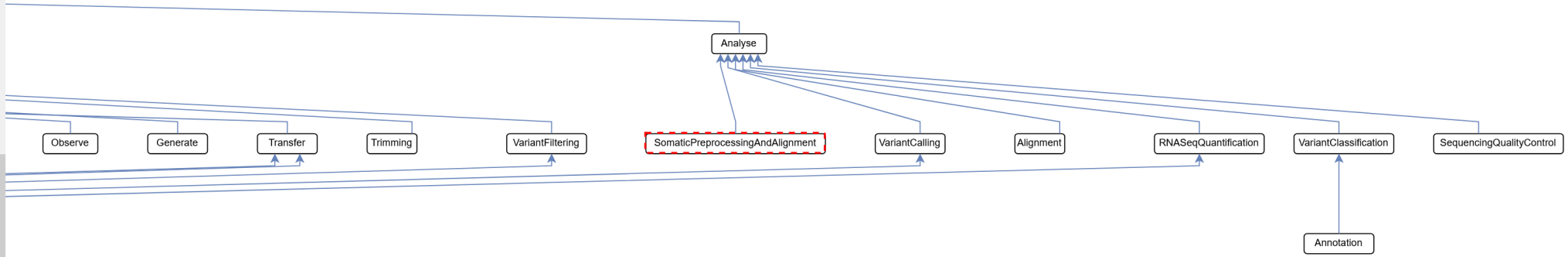
ICT abovo
Information & Communication Technologies

Create Entity

Information Model Editor
Policy Administration
Process Modeler
Process Negotiations
Datasets

- Organise
- Profiling
- Pseudonymise
- Query
- RNASeqQuantification
- ReadQuantification
- Record
- Reformat
- Remove
- Reproduction
- Restrict
- Retrieve
- Screen
- SequencingQualityControl
- Share
- ShareAlike
- Sharing
- SomaticPreprocessingAndAlignme
- SomaticVariantCalling
- SomaticVariantFiltering
- SourceCode
- Store
- Structure
- Tracking
- TrackingByFirstParty
- TrackingByThirdParty
- Transfer
- Transform
- Transmit
- Trimming
- Use
- VariantCalling
- VariantClassification
- VariantFiltering

nhrf nhrf
Settings
Log Out



Intragraph Relations | Intergraph Relations | Attributes

Add Relation

Enter node name... Detect

SomaticPreprocessingAndAlignment

Direction	Related Cell	Relation Type	
Select		Types:	
	AnyOperation	IS_A	
	Analyse	IS_A	

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File Tools

Data Types | Roles | Purposes | Operations | OperationContainerTypes | MachineTypes | Event Types | Context Types

Information Model Editor

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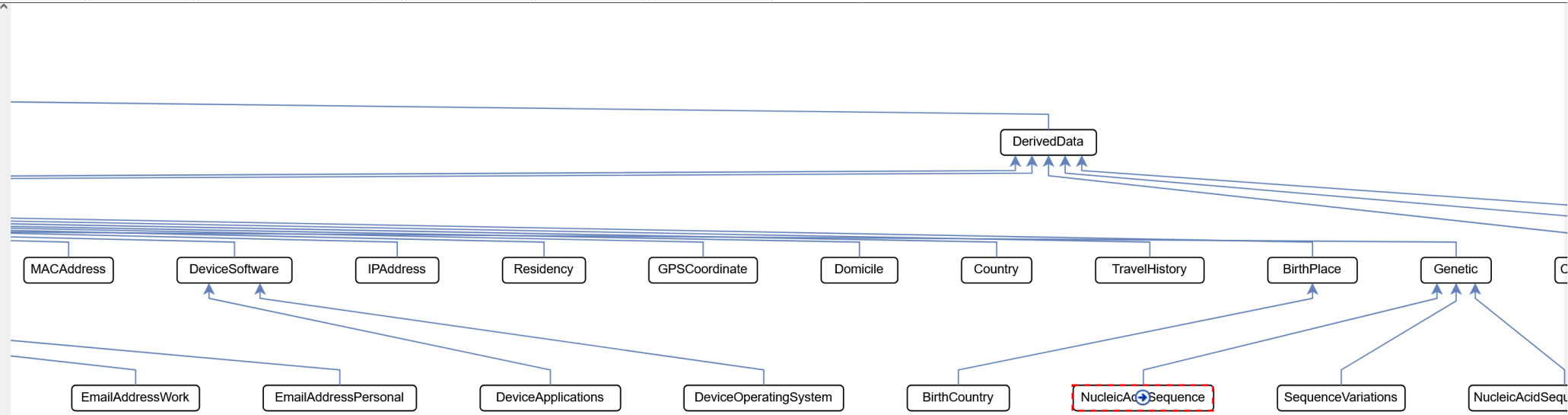
nhrf
nhrf

Settings

Log Out

Create Entity

Interaction
Interest
Internal
Job
KnowledgeBelief
Language
LifeHistory
Like
LinkClicked
LoanRecord
Locality
Location
MACAddress
MaritalStatus
Marriage
MedicalHealth
MentalHealth
Mood
Name
Nationality
NonPersonalData
NucleicAcidSequence
NucleicAcidSequenceAlignment
ObservedData
ObservedPersonalData
OfficialID
Offspring
Opinion
Ownership
PINCode
Parent
Passport
Password
PastEmployment



Intragraph Relations | Intergraph Relations | Attributes | Applicable Rules

Add Relation

NucleicAcidSequence

Direction	Related Cell	Relation Type
Select		Types:
	AnyDataType	IS_A
	Genetic	IS_A

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File

Create Rule

Information Model Editor

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Extract meta-rules

nhrf
nhrf

Settings

Search Applicable Rules

Log Out

Created Rules

Rule ID	Type	Description	Resource	Operation	Actor	Purpose	Derived From ...	Delete	Edit	View
	Select									
PERb52fc71164...	PERMISSIONS	Variants should ...	SequenceVariati...	VariantClassifica...	SeniorResearcher	ScientificResearch				
PER6a2aa6fa74...	PERMISSIONS	Variants should ...	SequenceVariati...	Annotation	SeniorResearcher	ScientificResearch	PERb52fc71164...			
PRO9e0cd11ddc...	PROHIBITIONS	Genetic data m...	NucleicAcidSeq...	Share	SeniorResearcher	ScientificResearch	PRO55b5f59533...			
PRO7f25e6e133...	PROHIBITIONS	Genetic data m...	SequenceVariati...	Share	JuniorResearcher	ScientificResearch	PRO55b5f59533...			
PRO0a9a5f9a1f...	PROHIBITIONS	Genetic data m...	NucleicAcidSeq...	Share	Researcher	ScientificResearch	PRO55b5f59533...			
PROebc74ead3...	PROHIBITIONS	Genetic data m...	NucleicAcidSeq...	Share	SeniorResearcher	ScientificResearch	PRO55b5f59533...			
PROb01bd7404...	PROHIBITIONS	Genetic data m...	NucleicAcidSeq...	Share	JuniorResearcher	ScientificResearch	PRO55b5f59533...			
PROfabb0b99b7...	PROHIBITIONS	Genetic data m...	SequenceVariati...	Share	SeniorResearcher	ScientificResearch	PRO55b5f59533...			
PRO9593024e1...	PROHIBITIONS	Genetic data m...	NucleicAcidSeq...	Share	Researcher	ScientificResearch	PRO55b5f59533...			
PRO9f1ebba0c8...	PROHIBITIONS	Genetic data m...	Genetic	Share	SeniorResearcher	ScientificResearch	PRO55b5f59533...			
PRO1ffa265f68e...	PROHIBITIONS	Genetic data m...	SequenceVariati...	Share	Researcher	ScientificResearch	PRO55b5f59533...			
PROf02bebd8e5...	PROHIBITIONS	Genetic data m...	Genetic	Share	JuniorResearcher	ScientificResearch	PRO55b5f59533...			
PRO55b5f59533...	PROHIBITIONS	Genetic data m...	Genetic	Share	Researcher	ScientificResearch				
PRO334789505...	PROHIBITIONS	Genetic data m...	NucleicAcidSeq...	Share	JuniorResearcher	ScientificResearch	PRO55b5f59533...			
PRO9691684ef4...	PROHIBITIONS	Genetic data m...	NucleicAcidSeq...	Move	Researcher	ScientificResearch	PRO1a0face7f7c...			
PRO970f55e360...	PROHIBITIONS	Genetic data m...	SequenceVariati...	Move	Researcher	ScientificResearch	PRO1a0face7f7c...			
PRO4c8a9303ee...	PROHIBITIONS	Genetic data m...	SequenceVariati...	CrossBorderTra...	Researcher	ScientificResearch	PRO1a0face7f7c...			
PRO40be9b56fb...	PROHIBITIONS	Genetic data m...	Genetic	CrossBorderTra...	Researcher	ScientificResearch	PRO1a0face7f7c...			
PROd9a893a83...	PROHIBITIONS	Genetic data m...	Genetic	Move	SeniorResearcher	ScientificResearch	PRO1a0face7f7c...			

File

Cancel

Information Model Editor

Policy Administration

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Process Negotiations

Datasets

Update Rule

nhrf
nhrf

Settings

Log Out

General

Rule ID PER6a2aa6fa74bd4dd494738145842526c1

Select Rule Type PERMISSIONS

Description Variants should be filtered before being annotated for the purpose of scientific research.

Variable Name: Purpose

Select Purpose: ScientificResearch — Select From Graph

Derived From Rule: PERb52fc71164bd4daeb58b31bd0f8a1c57

Define Action

Variable Name: Action_Inferred

Select Resource: SequenceVariations — Select From Graph — Add Constraint

Select Operation: Annotation — Select From Graph — Add Constraint

Select Actor: SeniorResearcher — Select From Graph — Add Constraint

PreActions

Pre-Action 1

Variable Name: Preaction1Inferred1

File

Cancel

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Update Rule

nhrf
nhrf

Settings

Log Out

PreActions

Pre-Action 1

Variable Name: Preaction1Inferred1

Select Resource: SequenceVariations — Select From Graph — Add Constraint

Select Operation: SomaticVariantFiltering — Select From Graph — Add Constraint

Select Actor: SeniorResearcher — Select From Graph — Add Constraint

PostActions

Define Contextual Condition

AND OR

Add Expression | Add Expression Group

File Edit

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Operations

Access
Adapt
Aggregate
Align
Alignment
Alter
Analyse
Annotation
Anonymise
Assess
Attribution

Datasets

nhrf_server_plx4720
skmel_transcript_counts
somatic_variants_melanoma

Variant annotation workflow

Cancel Update

Process | Constraints | Estimate Energy

New Process Details

Title: Variant annotation workflow

Description: This is a data processing workflow for variant annotation

Created At: 2026-10-06 18:53:00

Updated At: 2026-10-06 18:53:00

Initiators

AnyRole
AcademicScientificOrganisation
Adult
AmbulanceProvider
Applicant

SeniorResearcher

Purposes

AnyPurpose
AcademicResearch
AccountManagement
Advertising
AgeVerification
CombatClimateChange

ScientificResearch

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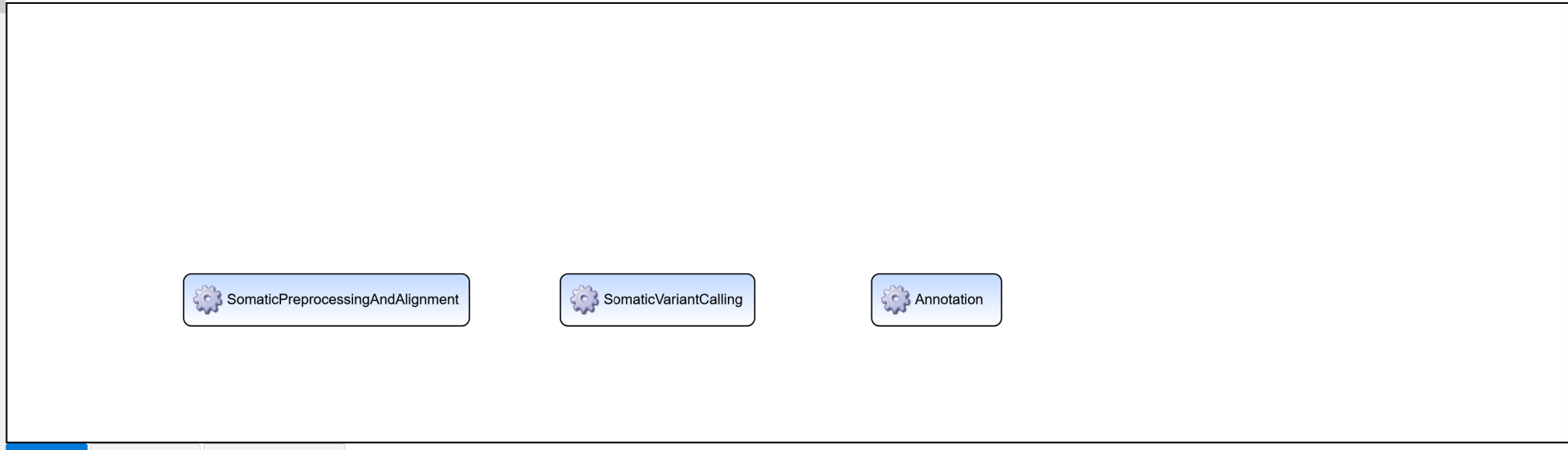
Variant annotation workflow

Cancel Update



Process | **Constraints** | **Estimate Energy**

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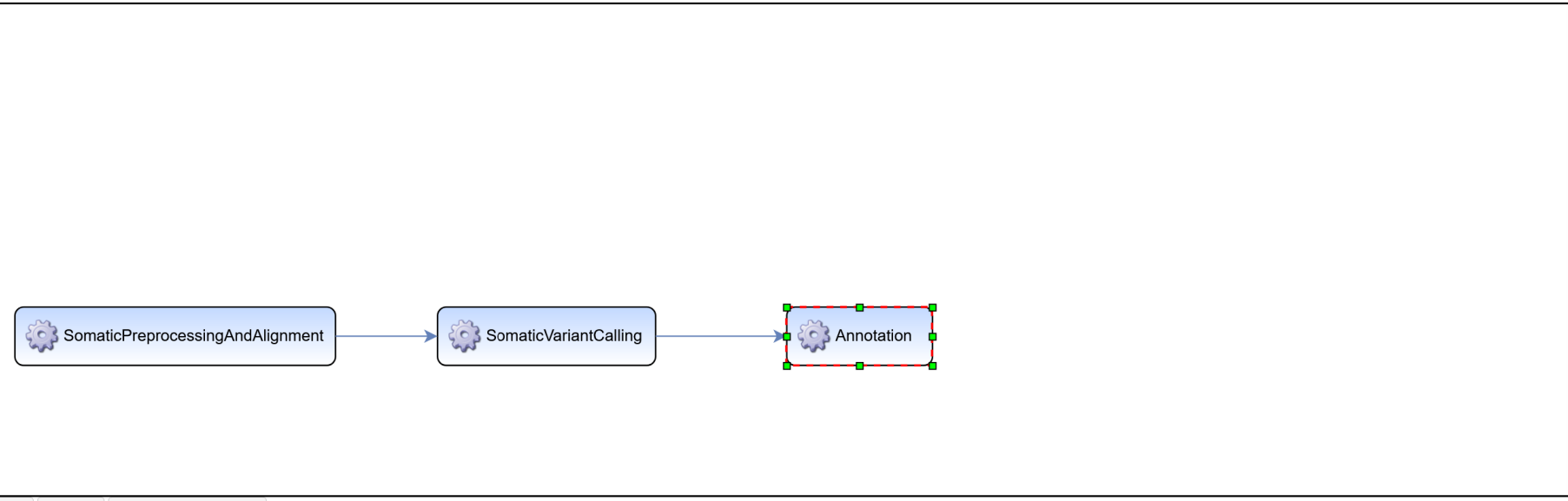

Process | Constraints | Task | Estimate Energy

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File Edit

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nhrf
nhrf

Settings

Log Out

Operations

- Access
- Adapt
- Aggregate
- Align
- Alignment
- Alter
- Annotation
- Analyse
- Anonymise
- Assess
- Attribution

Datasets

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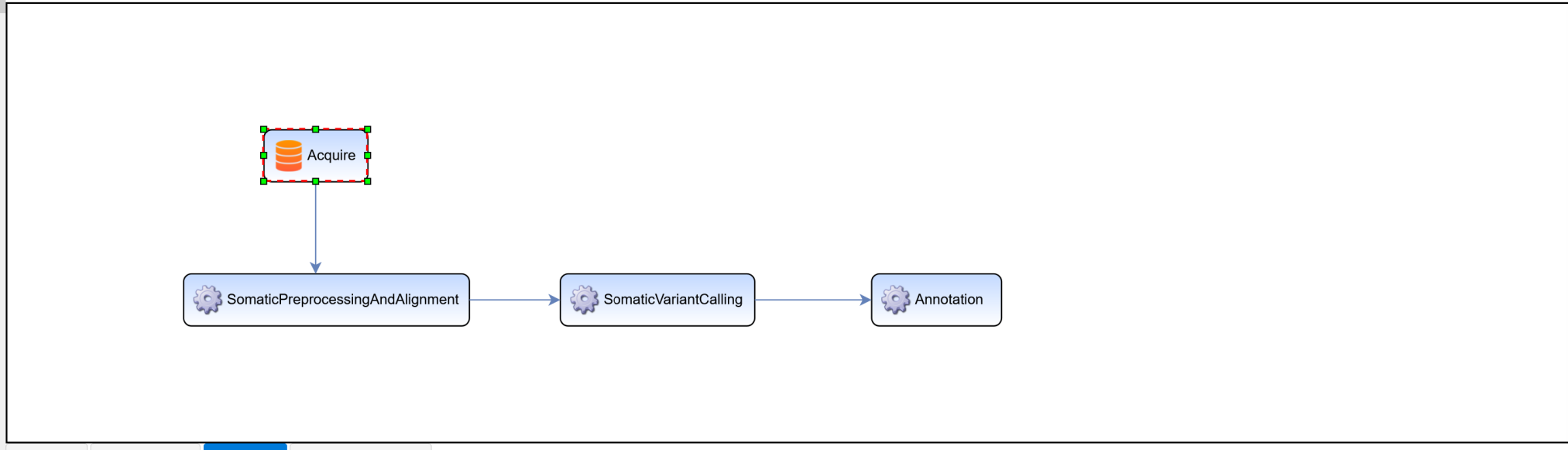
- skmel_transcript_counts
- somatic_variants_melanoma

Variant annotation workflow

Cancel Update



Process | Constraints | Dataset | Estimate Energy

Dataset Information

Semantic Type

Name

Marketplace IDs

Free text search

Search

Discovered Datasets

	ID	Name	Price
No result found			

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File Edit

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nhrf

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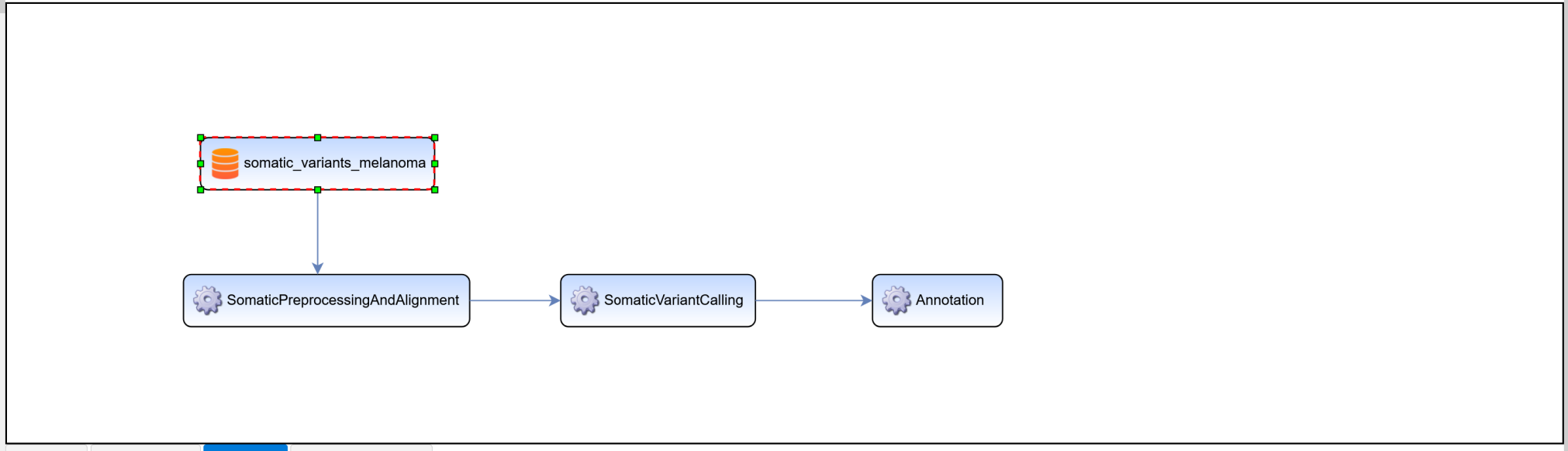

Process | Constraints | Dataset | Estimate Energy

Dataset Information:

Dataset ID	http://upcast-project.eu/dataset/somatic-variants-in-melanoma-version2
Title	Somatic Variants in Melanoma Version2
Semantic Type	NucleicAcidSequence
Description	Somatic variants
Type	
Themes	[]
Spatial	
Publisher ID	
Provider ID	
Distribution ID	



Datasets

nhrf_server_plx4720
skmel_transcript_counts
somatic_variants_melanoma

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Title	Somatic Variants in Melanoma Version2
Semantic Type	NucleicAcidSequence
Description	Somatic variants
Type	
Themes	[]
Spatial	
Publisher ID	
Provider ID	
Distribution ID	http://upcast-project.eu/dataset/somatic-variants-in-melanoma-version2/distribution/main
Policy ID	http://upcast-project.eu/policy/negoid-697cab55fe91db18ff7fff00-policyid-697cabd7fe91db18ff7fff02

Policy

Assignee **SeniorResearcher** is **allowed** to perform the action **Trimming** on resource **https://upcast-project.eu/dataset/64679ef1-77fd-49fe-891c-ec24c478f7e8**, for the purpose of **ScientificResearch**.

Assignee **SeniorResearcher** is **allowed** to perform the action **Alignment** on resource **https://upcast-project.eu/dataset/64679ef1-77fd-49fe-891c-ec24c478f7e8**, for the purpose of **ScientificResearch**.

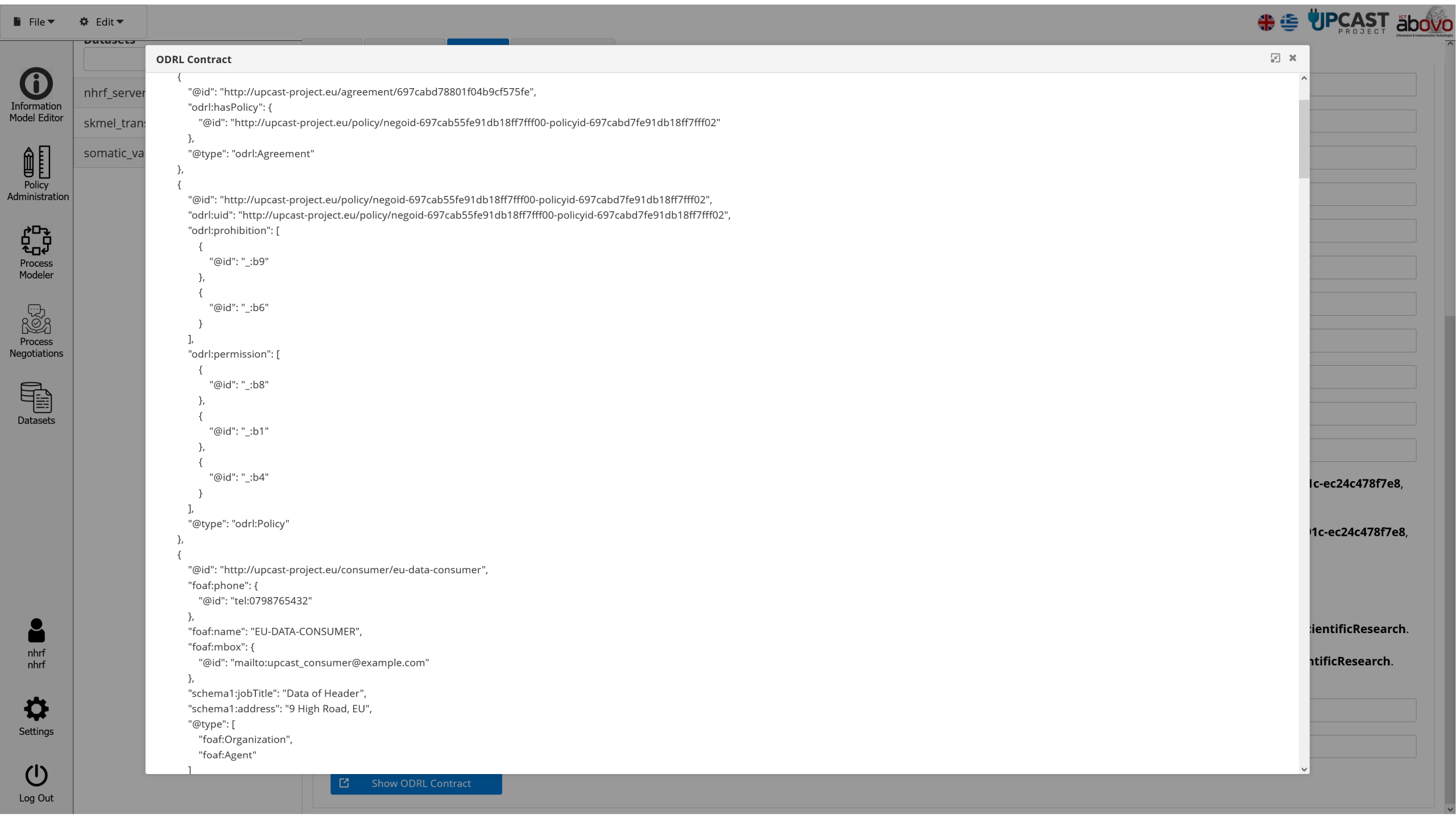
Assignee **SeniorResearcher** is **allowed** to perform the action **SequencingQualityControl** on resource **https://upcast-project.eu/dataset/64679ef1-77fd-49fe-891c-ec24c478f7e8**, for the purpose of **ScientificResearch**.

Assignee **SeniorResearcher** is **prohibited** from performing the action **Transfer** on resource **http://example.org/datasets/**, for the purpose of **ScientificResearch**.

Assignee **SeniorResearcher** is **prohibited** from performing the action **Share** on resource **http://example.org/datasets/**, for the purpose of **ScientificResearch**.

Price	0.0
Price Unit	USD/Month

Show ODRL Contract


File
Edit
Information Model Editor
Policy Administration
Process Modeler
Process Negotiations
Datasets
nhrf
nhrf
Settings
Log Out
nhrf_server
skmel_trans
somatic_va
ODRL Contract
{
"@id": "http://upcast-project.eu/agreement/697cabd78801f04b9cf575fe",
"odrl:hasPolicy": {
"@id": "http://upcast-project.eu/policy/negoid-697cab55fe91db18ff7fff00-policyid-697cabd7fe91db18ff7fff02"
},
"@type": "odrl:Agreement"
},
{
"@id": "http://upcast-project.eu/policy/negoid-697cab55fe91db18ff7fff00-policyid-697cabd7fe91db18ff7fff02",
"odrl:uid": "http://upcast-project.eu/policy/negoid-697cab55fe91db18ff7fff00-policyid-697cabd7fe91db18ff7fff02",
"odrl:prohibition": [
{
"@id": "_:b9"
},
{
"@id": "_:b6"
}
],
"odrl:permission": [
{
"@id": "_:b8"
},
{
"@id": "_:b1"
},
{
"@id": "_:b4"
}
],
"@type": "odrl:Policy"
},
{
"@id": "http://upcast-project.eu/consumer/eu-data-consumer",
"foaf:phone": {
"@id": "tel:0798765432"
},
"foaf:name": "EU-DATA-CONSUMER",
"foaf:mbox": {
"@id": "mailto:upcast_consumer@example.com"
},
"schema1:jobTitle": "Data of Header",
"schema1:address": "9 High Road, EU",
"@type": [
"foaf:Organization",
"foaf:Agent"
]
Show ODRL Contract

File Edit

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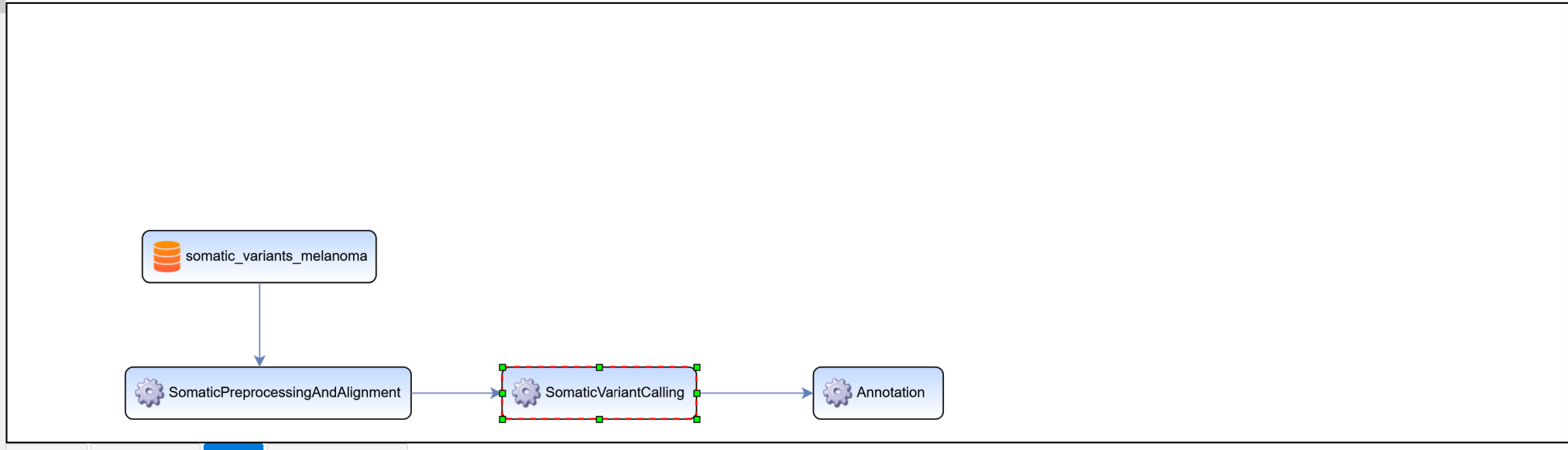
Assess
Attribution

Datasets

nhrf_server_plx4720
skmel_transcript_counts
somatic_variants_melanoma

Variant annotation workflow

Cancel Update



Process | Constraints | Task | Estimate Energy

SomaticVariantCalling Task Information

Task TNdc33aff03d5a4d78a16b9 **Description:** Add a description for task...

+

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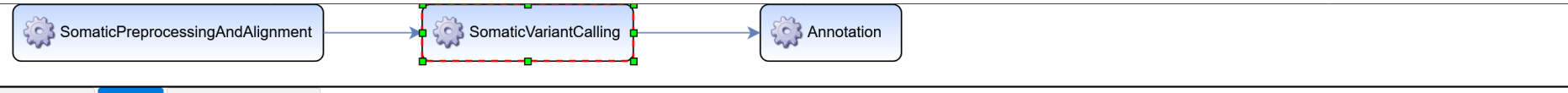
nhrf_server_plx4720

skmel_transcript_counts

somatic_variants_melanoma



Process | Constraints | Task | Estimate Energy

SomaticVariantCalling Task Information

Task TNdc33aff03d5a4d78a16b9 **Description:** Add a description for task...

Execution Profile 1

Add Operation SomaticVariantCalling — Add Constraint

Add Actor

AND — Add Actor | Clear

SeniorResearcher — Select From Graph | Add Constraint | Delete

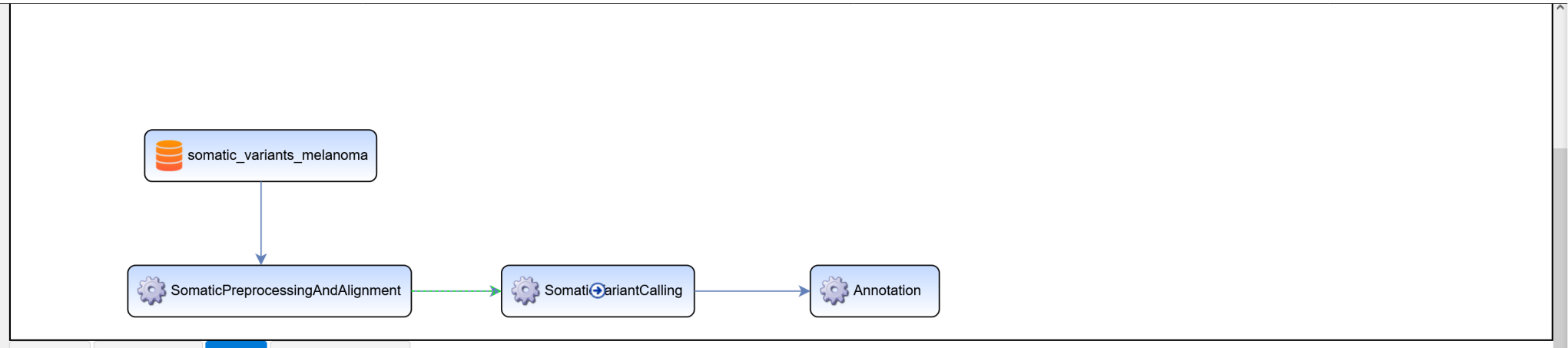
Add Asset

AND — Add Asset | Clear

NucleicAcidSequence — Select From Graph | Add Constraint | Delete

Dataset somatic_variants_melanoma

Add Condition



Process | Constraints | Edge | Estimate Energy

EDd9266f370dfc4ef280f1d5fc94795212 Edge Information

Edge ID EDd9266f370dfc4ef280f1d5 **Description:** Enter Description... **Type:** PLAIN

Add Condition

AND OR + Add Expression + Add Expression Group

Information Entities

AND + Add Entity ✖ Clear

NucleicAcidSequence Select From Graph Add Constraint ✖ Delete

Dataset somatic_variants_melanoma

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File Edit

Verify Process Model
Save
Export SVG...
Export PNG...
Export State...
Export Ontology...
Export Rich Ontology...
Export Nextflow script

Process Modeler version:
WFMa94eae05e89b45f2802f9f793f83afe0_copy

Modeler

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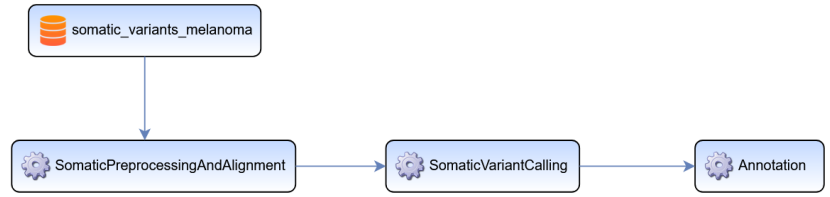
Variant annotation workflow

Cancel Update



Process | **Constraints** | **Estimate Energy**

New Process Details

Title: Variant annotation workflow

Description: This is a data processing workflow for variant annotation

Created At: 2026-10-06 18:53:00

Updated At: 2026-10-06 19:15:19

Initiators

AnyRole
AcademicScientificOrganisation
Adult
AmbulanceProvider
Applicant

SeniorResearcher

Purposes

AnyPurpose
AcademicResearch
AccountManagement
Advertising
AgeVerification
CombatClimateChange

ScientificResearch

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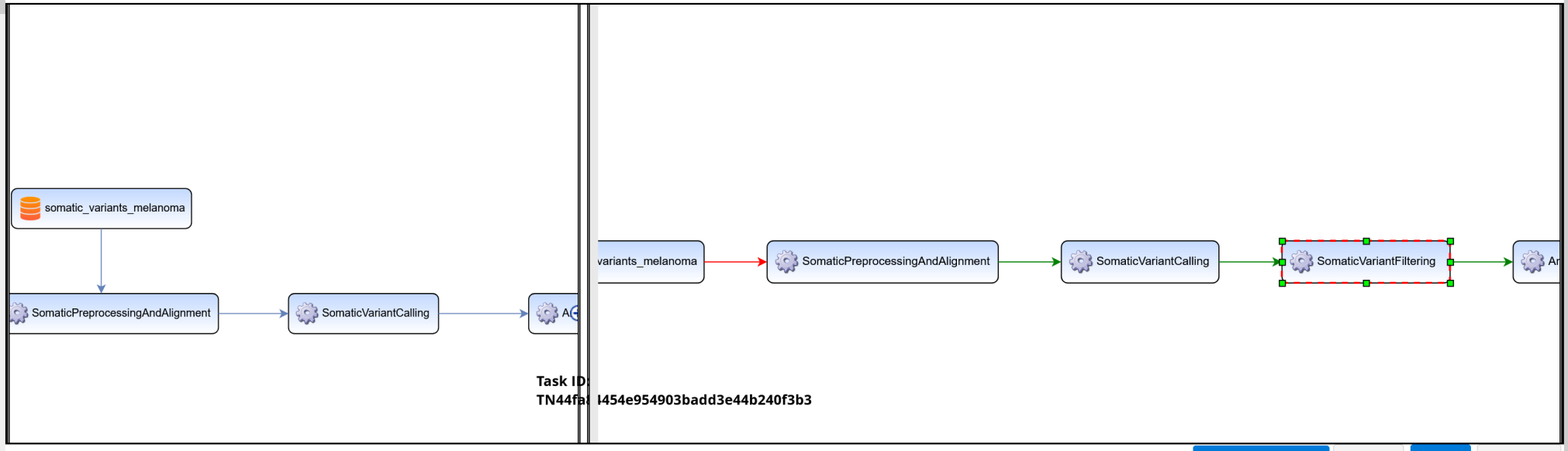
Variant annotation workflow

Cancel | Update



Task ID:
TN44fa[illegible]454e954903badd3e44b240f3b3

Adopt Verified | Initial | Split | Verified

Process | Constraints | Task | Estimate Energy

SomaticVariantFiltering Task Information

Task TN8205f7a6035d4cea8a392 **Description:** Add a description for task...

Execution Profile 1

Add Operation SomaticVariantFiltering — Add Constraint

Add Actor

AND — Add Actor | Clear

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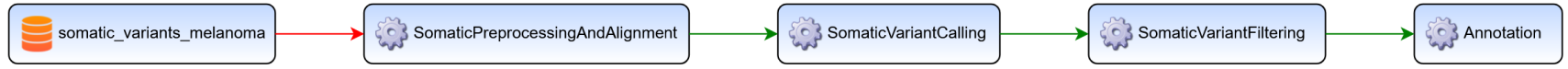
skmel_transcript_counts
somatic_variants_melanoma

Variant annotation workflow

Cancel Update



Process | Constraints | Estimate Energy | Conflicts

New Process Details

Title: Variant annotation workflow

Description: This is a data processing workflow for variant annotation

Created At: 2026-10-06 19:24:16

Updated At: 2026-10-06 19:24:16

Initiators

AnyRole
AcademicScientificOrganisation
Adult
AmbulanceProvider
Applicant

SeniorResearcher

Purposes

AnyPurpose
AcademicResearch
AccountManagement
Advertising
AgeVerification
CombatClimateChange

ScientificResearch

Conclusions and key takeaways

- A **shared semantic foundation** connects organisational concepts, access and usage policies, and workflow models.
- **Visual workflow modelling** and **automatic executable script generation** reduce the effort required to implement compliant pipelines.
- **Automatic verification** checks the intended processing against organisational policies and dataset providers' constraints, identifying conflicts before execution.
- **Automatic workflow re-engineering** turns policy requirements into concrete adaption of the pipeline.
- Overall, bringing these capabilities together **simplifies** both **workflow development** and **compliance**, thereby supporting the use of external datasets under agreed terms.

Σας ευχαριστώ!

Ερωτήσεις;



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