Unified Foundational Ontology and Ontology Testing

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Outline

Idea

- We will use Unified Foundation Ontology (UFO) as main upper level ontology to guide development of domain level ontology and consequently application ontologies.
- Theoretical background behind the UFO will help us to validate our design decisions during the ontology development.

Unified Foundational Ontology

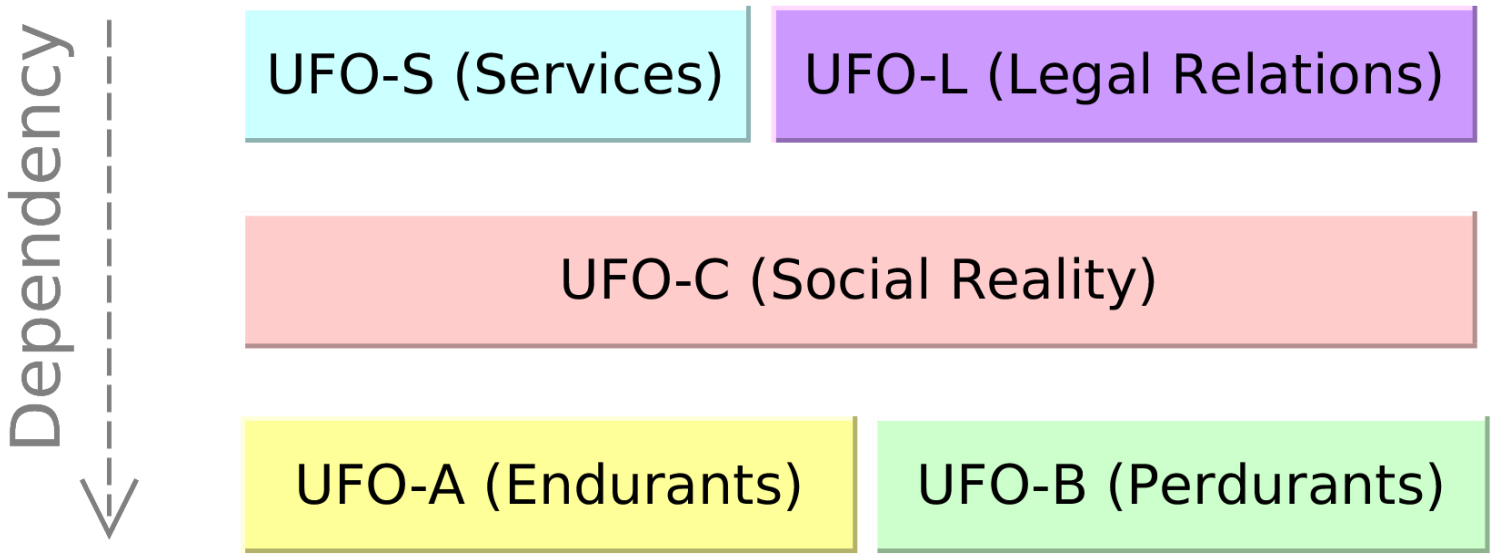
Introduction

What is Unified Foundational Ontology (UFO) ?

- a foundational ontology developed by Giancarlo Guizzardi et al.
- a descriptive ontology representing universals and particulars, endurants and perdurants
- based on theories from Formal Ontology, Philosophical Logics, Philosophy of Language, Linguistics and Cognitive Psychology
- incorporates ideas from GFO, DOLCE and the Ontology of Universals underlying OntoClean

UFO Modules

UFO Core Modules Structure

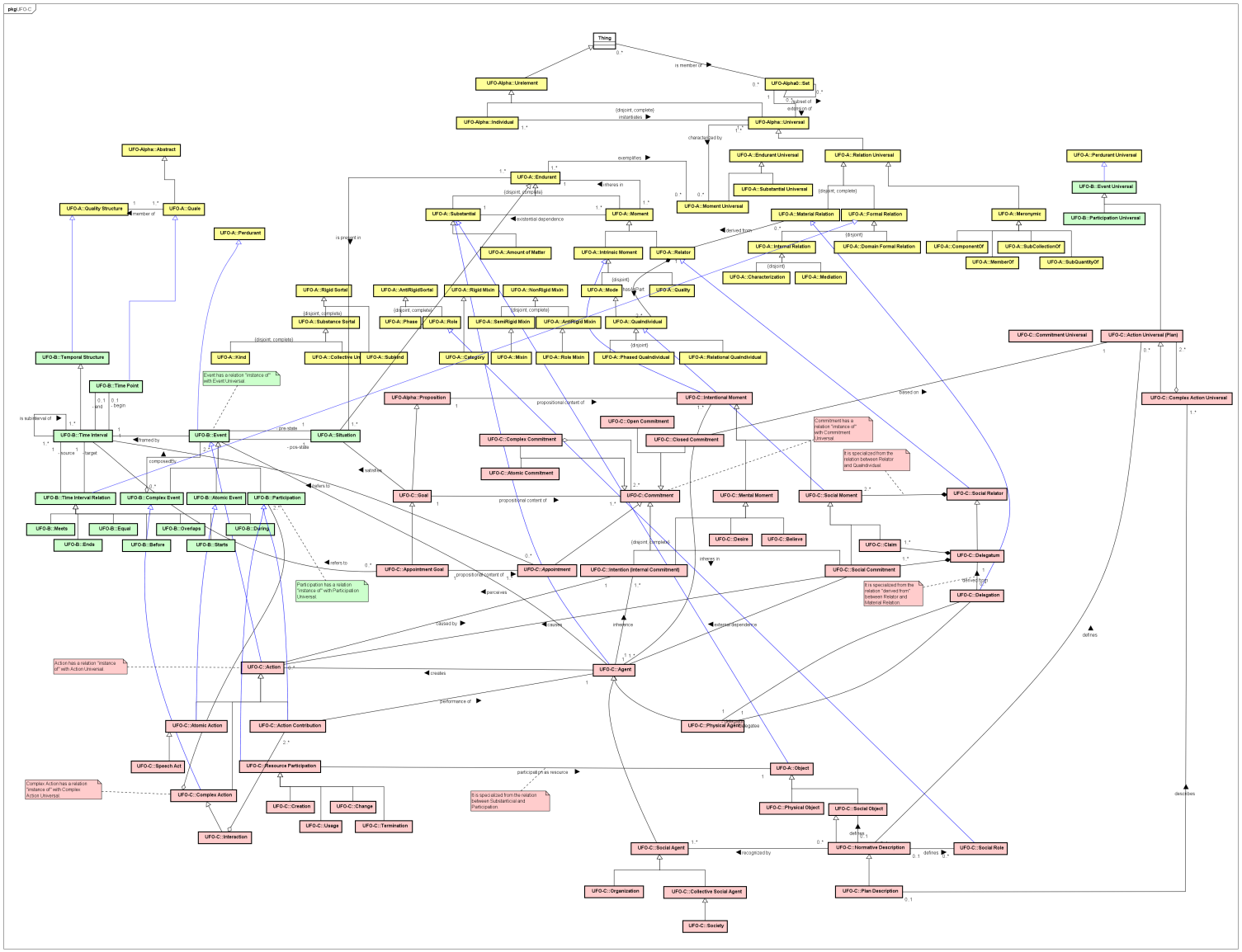


UFO Core Modules Overview[1]

- **UFO-A** – an ontology of *endurants* dealing with aspects of structural conceptual modeling such types and taxonomic structures, part-whole relations, particularized intrinsic properties, attributes and attribute value spaces, particularized relational properties and relations, roles [3].
- **UFO-B** – an ontology of *perdurants* (*events*, *processes*) including perdurant mereology, temporal ordering of perdurants, object participation in perdurants, causation, change and the connection between perdurans and endurants via dispositions [6].
- **UFO-C** – an ontology of *intentional and social entities* addressing notions such as beliefs, desires, intentions, goals, actions, commitments and claims, social roles and social particularized relational complexes (social relators) [4].
- **UFO-S** – on ontology for *commitment-based services* [7].
- **UFO-L** – an ontology representing *legal domain* [2].

[1] For detailed overview see [4, 5]

Relations within Core Modules of UFO



Relations among concepts of *UFO-A*, *UFO-B*, and *UFO-C* modules taken from `http://ontouml.org`.

Categorization of Object Types

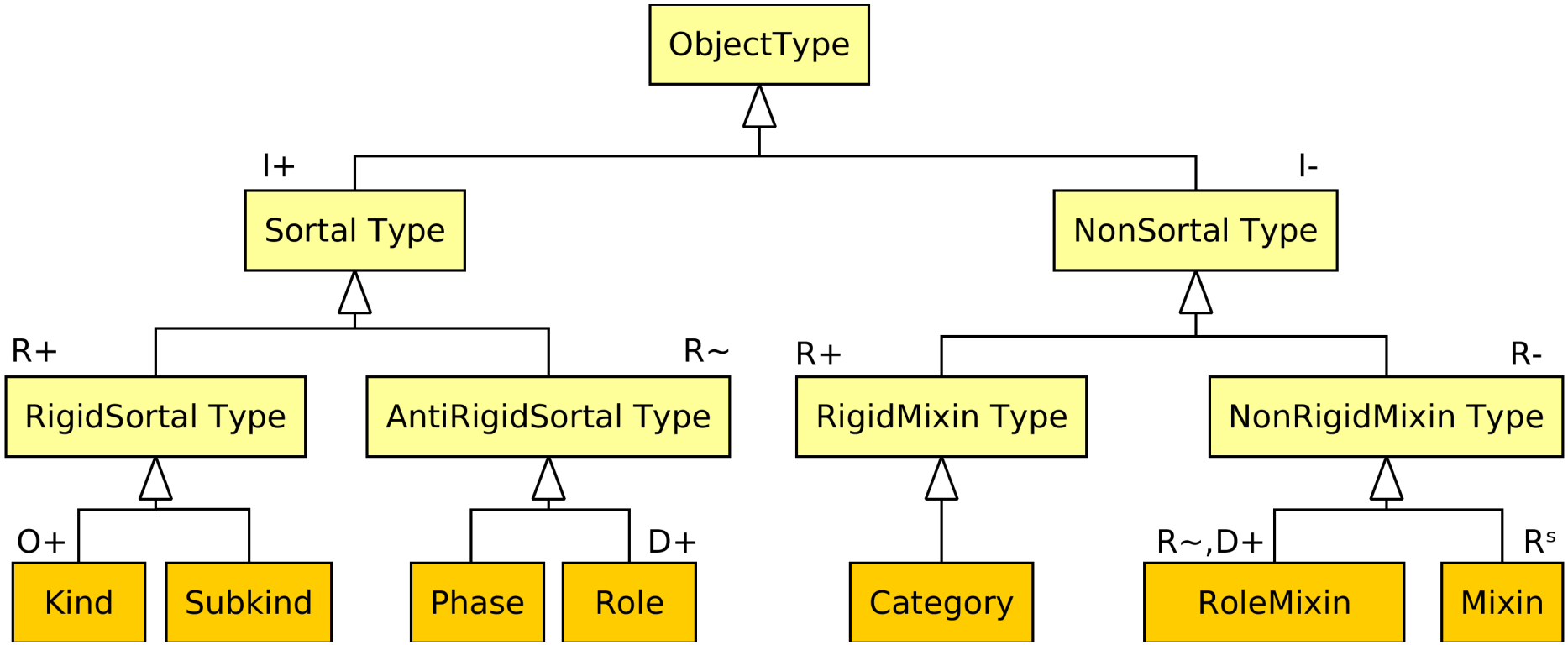
Ontological Meta-properties of Object Types

Let $\mathbf{T}$ be an object type[2].

- Identity
  - $\mathbf{I}^{+}(\mathbf{T})$ – carries identity
  - $\mathbf{O}^{+}(\mathbf{T})$ – owns (supply) identity
- Rigidity
  - $\mathbf{R}^{+}(\mathbf{T}) = \Box(\forall x\, T(x) \rightarrow \Box(T(x)))$ (Rigid)
  - $\mathbf{R}^{-}(\mathbf{T}) = \neg\mathbf{R}^{+}(\mathbf{T}) = \Diamond(\exists x\, T(x) \wedge \Diamond\neg T(x))$ (Non-Rigid)
  - $\mathbf{R}^{\sim}(\mathbf{T}) = \Box(\forall x\, T(x) \rightarrow \Diamond(\neg T(x)))$ (Anti-Rigid)
  - $\mathbf{R}^{s}(\mathbf{T}) = \mathbf{R}^{-}(\mathbf{T}) \wedge \neg\mathbf{R}^{\sim}(\mathbf{T})$ (Semi-Rigid)
- Relational Dependance
  - $\mathbf{D}^{+}(\mathbf{T}, \mathbf{T}', \mathbf{R}) =_{def} \Box(\forall x\, T(x) \rightarrow \exists y\, T'(y) \wedge R(x, y))$

[2] Might be also referred as "Substantial".

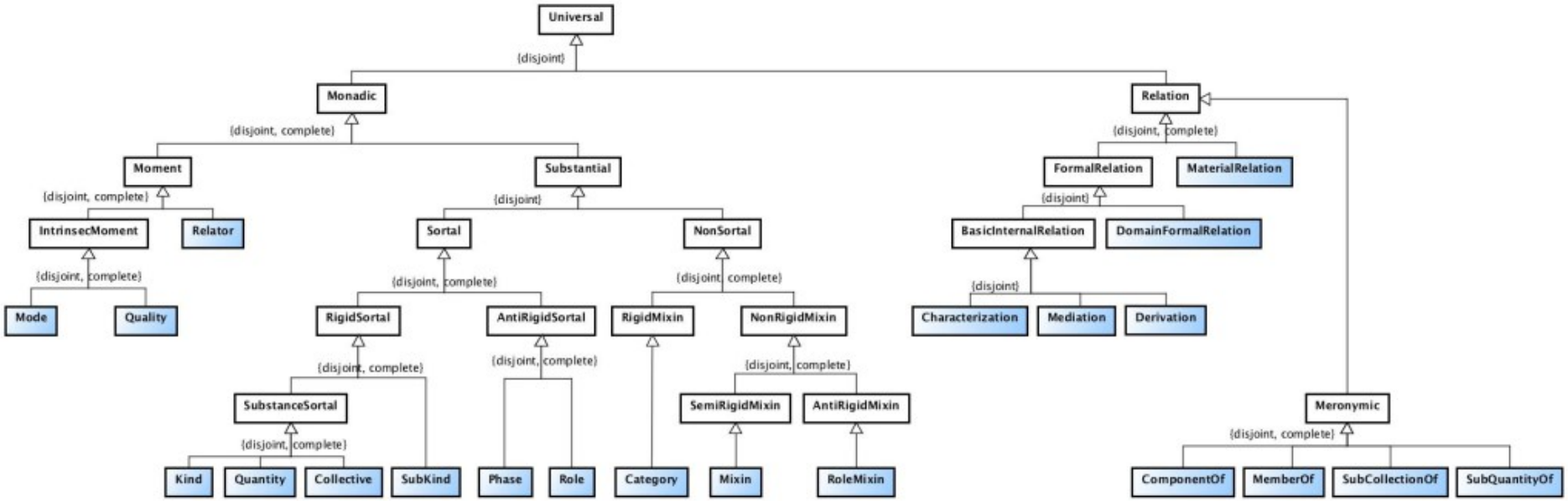
Categories of Object Types



For detailed explanation of the categories see

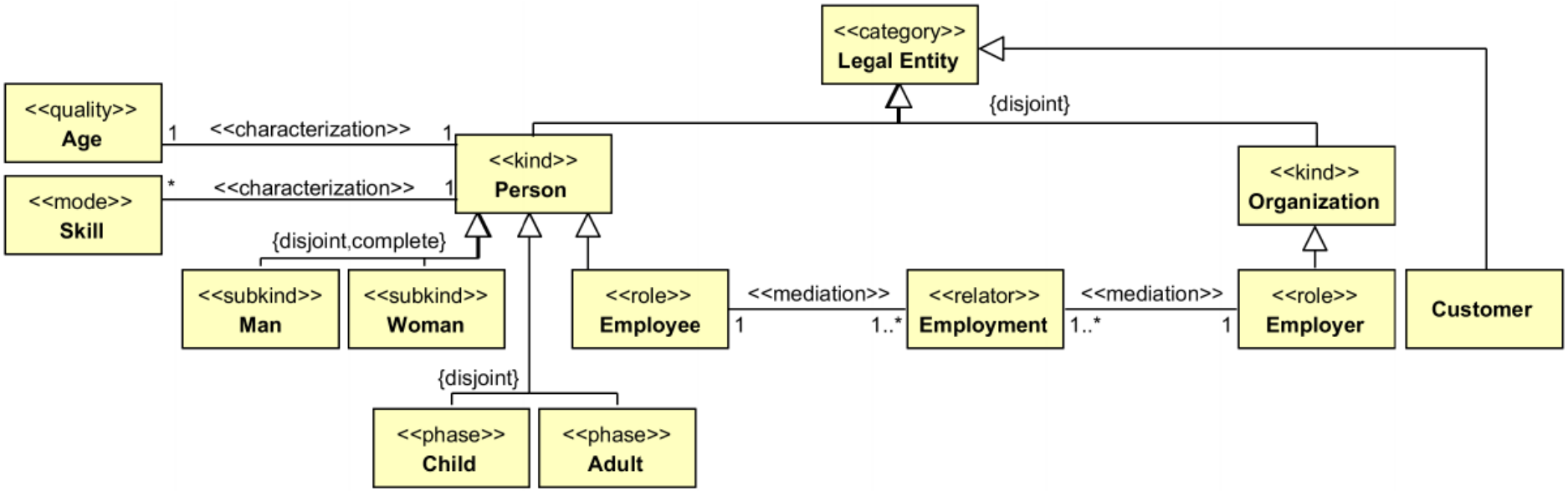
`http://guizzardi.panrepa.org/PUE-2016-p3.pdf`

Categories of All Universals



Categorization of all universals taken from `http://ontouml.org`.

An Example



An example of UFO based model in OntoUML taken from [1].

Ontology Testing

Ontology Testing

to be continued ...

Related resources

- UFO represented in OWL2 ontology – `http://onto.fel.cvut.cz/ontologies/ufo`
- OntoUML community portal – `https://ontouml.org/`
- Menthor Editor (an OntoUML editor) – `http://www.menthor.net/`
- Guizzardi's course materials – `http://guizzardi.panrepa.org/`

References

[1] Victorio A Carvalho et al. "Multi-level ontology-based conceptual modeling". In: *Data & Knowledge Engineering* (2017).

[2] Cristine Griffo, João Paulo A Almeida, and Giancarlo Guizzardi. "Towards a Legal Core Ontology based on Alexy's Theory of Fundamental Rights". In: *MWAIL, ICAIL 2015* (2015).

[3] Giancarlo Guizzardi. *Ontological foundations for structural conceptual models*. CTIT, Centre for Telematics and Information Technology, 2005.

[4] Giancarlo Guizzardi, Ricardo de Almeida Falbo, and Renata SS Guizzardi. "Grounding Software Domain Ontologies in the Unified Foundational Ontology (UFO): The case of the ODE Software Process Ontology." In: *CIbSE*. 2008, pp. 127–140.

[5] Giancarlo Guizzardi et al. "Towards ontological foundations for conceptual modeling: the unified foundational ontology (UFO) story". In: *Applied ontology* 10.3-4 (2015), pp. 259–271.

[6] Giancarlo Guizzardi et al. “Towards ontological foundations for the conceptual modeling of events”. In: *International Conference on Conceptual Modeling*. Springer. 2013, pp. 327–341.

[7] Julio Cesar Nardi et al. “Towards a commitment-based reference ontology for services”. In: *Enterprise Distributed Object Computing Conference (EDOC), 2013 17th IEEE International*. IEEE. 2013, pp. 175–184.