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BPRN: A Formal Model of Resources Consumption in Business Process Based on an Extension of Petri-Net and Workflow model

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Abstract

In world of industry, the deployment and execution of business processes can be a very costly investment. The problem is in extreme situations; companies need additional resources to ensure the smooth running of business process. Moreover, they need to know exactly when a business process needs more resources, to be able to use cloud resources.

In this work, we have defined a formal model that supports the specification and analysis of company requirements in resources and allows simulating many parallel executions of business process. To detect situations that can be caused by the lack of resources in business process execution.

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1. Introduction

In the last years, Business Process Management (BPM)¹⁴ has gained a lot of popularity among companies, since it allows managing and optimizing their business process. The business process can be considered as a set of activities, which are performed by humans or systems.

In the world of industry, and due to the many resources that are required for business process managing, the deployment and execution of such processes can be a very costly investment. Furthermore, companies need to

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purchase additional resources to ensure that each user's request can be executed in any situations (extreme situation). Then, problem is that all of these additional resources are used only for a very limited time lapse, and we cannot predict the exact number of customers that cause the problem of deadlock situation. Moreover, companies need to know exactly when the business process needs more resources to be able to avoid a deadlock situation by using cloud resources, which ensures the smooth running of business process.

Cloud computing can play an important role in managing and constructing the business process. In fact, the basic idea of cloud computing is to give the possibility of using computing resources in a pay-per-use manner and it provides the illusion to perceive resources such as unlimited computer resources⁸. These resources are invoked to respond to user requests and by paying only their real consumption. Moreover, cloud computing has a very important concept of elasticity that distinguishes it from the other ones³; the elasticity is allocated and revoked resources dynamically and it can considerate such as a permanent reconfiguration of resources.

Some formal methods in BPM would help companies to meet their goals of process managing and increasing their process quality. The real benefits are finding defects earlier and automating checking of some properties. There are many formal methods that can be applied to BPM, like: petri nets, workflow-based models, etc. In particular, the Petri net⁹ can be applied to graphically model the system behaviour and describe relationships between the system conditions and events. So, we can consider a petri net as a good candidate to formalize the consumption resources of business process; by reconfiguring the resource consumption for the smooth running of business process in any situation. However, the problem is that, some resource information of business process services cannot be represented in petri net.

The methods used in companies are rarely formally. So, in order to be incorporated into company practice; we have defined a new formal model that supports the specification and analysis according to company requirements. Furthermore, this model allows to simulate many parallel executions of business process. In order to detect early the deadlock situation that can be caused by the lack of resources in business process execution. Moreover, to avoid the deadlock situation, we need to decompose and migrate business process toward a cloud computing for using more resources.

Until now, there are only few formal models for the decomposition of business process. But we are unaware of approaches involving a formal model based on resource consumption for business process decomposition.

In overall terms, our perspective is to define a formal model to detect the deadlock situation by the simulation of many executions of business process simultaneously. In order to allow companies to reconfigure the resources that are allocated to business process. Furthermore, this formal model is based on an extension of petri net and workflow model.

The contribution of this paper is to provide a new approach for the decomposition of business process services based on their resource consumption and using a formal method. Where the part of a business process that consumes more resources and causes the problem of deadlock will be hosted on the cloud computing and the other part of a business process will be hosted on the company.

The rest of this paper is organized as follows: Section 2 introduces some basic main concepts necessary in this work. Section 3 presents the proposed model called Business Process Resources Net model that we have used in business process decomposition. Moreover, we present in this section some examples that illustrates and shows the applicability of this approach. Section 4 discusses the approach by detailing the contributions of this paper and overviews some related work. Finally, section 5 gives our final remarks by concluding this paper and presenting some future directions.

2. Basic concept

2.1. Petri net and workflow-net

Petri net is considered as a directed graph, it's the combination of two kinds of nodes: the places and transition; places and transitions are connected by arcs. Arcs link places to transition or vice versa. The place corresponds to a system state variable that will be modeled and the transition is an action that will lead to evolution of system state variables. In additional, workflow-net (WF-net) is a specialization of Petri nets. WF-net is proposed in order to capture flow control description of the business process. Moreover, WF-net is considered such as modeling of all or part of a business process tasks. Formally, Petri net and WF-net are defined as follows:

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