软件学院 **2010** 级软件工程专业(2012 春季学期)

《工作流技术》期末试题答案(A)

(考试形式：闭卷　　考试时间：2 小时)

警示

《中山大学授予学士学位工作细则》第六条

考试作弊不授予学士学位

方向：_____　　姓名：_____　　学号：_____

出卷：_____　　审核：_____

一、名词解释（每小题 5 分，共 30 分）

1. 业务过程(Business Process): p238. A business process is one focused upon the production of particular products. These may be either physical products, such as an aircraft or bridge, or less tangible ones such as a design, a consultation paper, or an assessment. In other words, the "product" can also be a service.
2. 案例(Case): p239. A case is what a workflow management system is designed to control. We can also regard it as a "product in progress." Examples of a case could include an insurance claim, a mortgage application, a tax return, an order, or a course of treatment in a hospital. Each case has a unique identity. Moreover a case is always at a particular stage of development at any given moment.
3. 活动(Activity): p235. An activity is the carrying out of an assigned task. In contrast to a task, an activity is related to a specific case.
4. 合理性(Soundness)：P246. Soundness is a correctness criterion defined for workflow nets, that is, Petri nets that represent workflow processes. A workflow net is sound if, for any case, the procedure will terminate eventually and the moment the procedure terminates there is a token in the sink place and all the other places are empty. Moreover there should be no dead transitions; in other words, it should be possible to execute an arbitrary task by following the appropriate route though the workflow net.
5. WFMS(Workflow Management System): p249. A workflow management system is a software package for the implementation of a workflow system. The term refers to a universally applicable system; in other words, a workflow management system is not customized to a specific business situation. By configuring such a system, it is turned into one which supports specific workflows. Unlike a workflow system, a workflow management system is thus a generic application.
6. 时态工作流（Temporal Workflow）. 时态工作流就是将时间作为一个维度引入工作流系统，全面、系统地研究工作流系统中各元素及元素间关系的时态特性及其规律。.

二、简答题（每小题 6 分， 共 30 分）

1. 简述给工作项(Work Item)分配资源的策略。

1) Let a resource practice its specialty. A resource can often perform a large number of tasks. Usually, though, there are some in which it specializes.

2) As far as possible, let a resource do similar tasks in succession. Both people and machines require so-called set-up times. By this we mean the (additional) time required to begin performing a new task. By carrying out

similar tasks one after the other, the set-up times can be cut down. Furthermore in the case of work of a repetitive nature, people can reduce their average processing time by using routine.

3) Strive for the greatest possible flexibility for the near future. If we have a choice between two resources of equal value to perform a work item, it is wise to select the one that can carry fewer work items of other types.

2. 简述 WfMC 工作流参考模型五个接口的作用。

1) Interface 1 (process definition tools). Interface 1 provides the link between the tools designed for creating and modifying the workflow definitions (process definition tools) and the workflow enactment service.
2) Interface 2 (workflow client applications). The second interface is dedicated to communication between the worklist handler and the enactment service.
3) Interface 3 (invoked applications). An application is opened from the workflow management system through Interface 3.
4) Interface 4 (other workflow enactment services). Interface 4 enables the exchange of work between several autonomous workflow systems(for example, case transfers and the outsourcing of work items).
5) Interface 5 (administration and monitoring tools). Interface 5 is concerned with the link between administration and monitoring tools and the workflow enactment service. It is subdivided into two parts: workflow system management functions and workflow tracking functions.

3. 简述适应性工作流应处理的五个方面的变更。

Classification of change

1) process perspective: tasks are added or deleted or their ordering is changed,
2) resource perspective: resources are classified in a different way or new classes are introduced,
3) control perspective: changing the way resources are allocated to processes and tasks,
4) task perspective: upgrading or downgrading tasks, and
5) system perspective: changes to the infrastructure or the configuration of the engines in the enactment service.

For workflow management systems, the process perspective is dominant.

4. 简述工作流执行服务间的四种协同工作模型（接口 4，互操作）。

1) 模型 1 —— 链锁式（Chained）：过程 A 中的一个连接点，连接到过程 B 中的一个连接点。

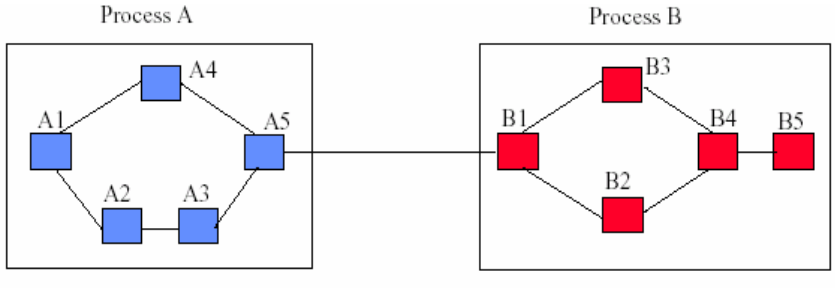


Figure 13 - Chained Services Model

2) 模型 2 —— 子过程嵌套（Nested Subprocesses）

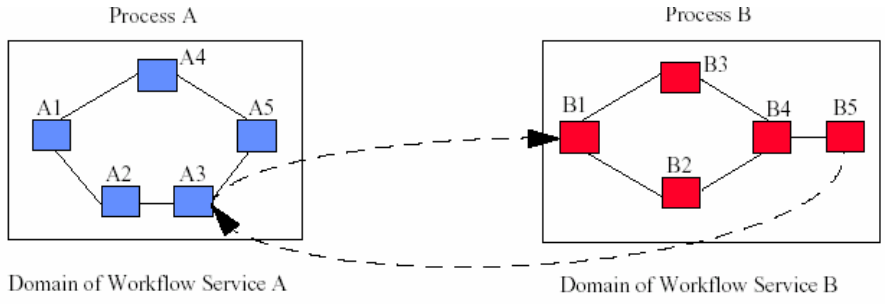


Fig 14 - Nested Subprocesses Model

3) 模型 3 —— P2P （Peer-to-Peer）

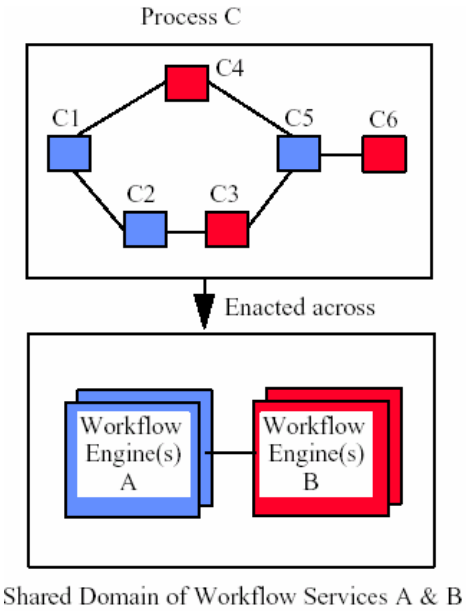


Fig 15 - Peer-Peer Model

4) 模型 4 —— 相似同步（Parallel Synchronised）

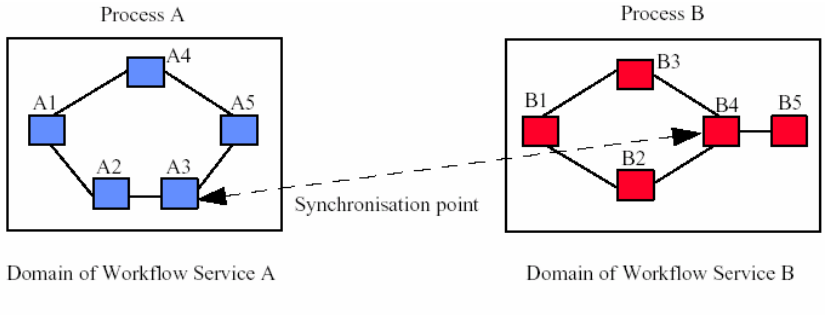


Fig 16 - Parallel Synchronised Model

5. 简述工作流性能分析的三种方法。

1) Markovian analysis

Markov chain is a reachability graph with the probability of transitions added to it.

what are the chances of a case taking a particular route through a process. By expanding Markov chains with cost and time aspects, a range of performance indicators can be generated.

2) Queueing theory

Queueing theory is intended for the analysis of systems in which the emphasis is placed upon such performance indicators as waiting times, completion times, and utilization of capacity.

single queue, queueing networks

in the presence of parallel routing, it is often impossible to apply the results obtained from queueing theory.

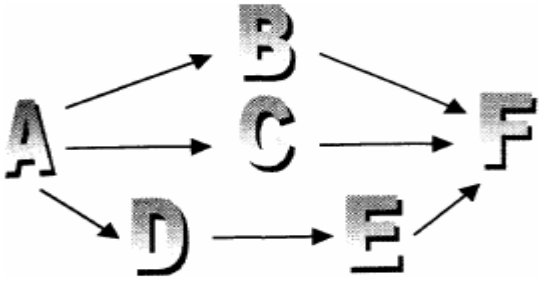
3) Simulation.

Simulation is a very flexible analysis technique. It almost always is possible to analyze a workflow using it. In fact, simulation boils down to the following of a path in the reachability graph. In doing so, particular choices are made based upon various probability distributions.

Because simulation is nothing more than the repeated execution of a process with the aid of a computer, it is a technique that is accessible to people without a mathematical background.

三、分析设计题（共 40 分）

1．一个政府的机密项目要求一个人执行六个任务：A、B、C、D、E、F，下图指明了这六个任务被执行的顺序（优先图），如：ABDCEF 就是一种可能的执行序列。



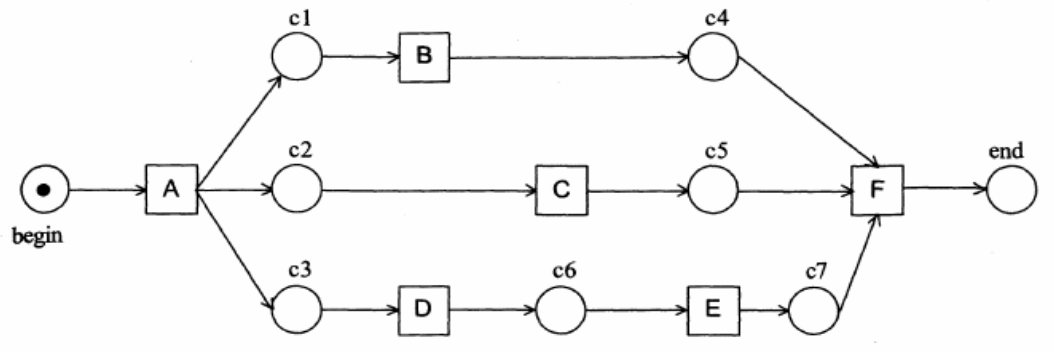
要求：

1） 用 WF-net 对这个项目建模；（5 分）

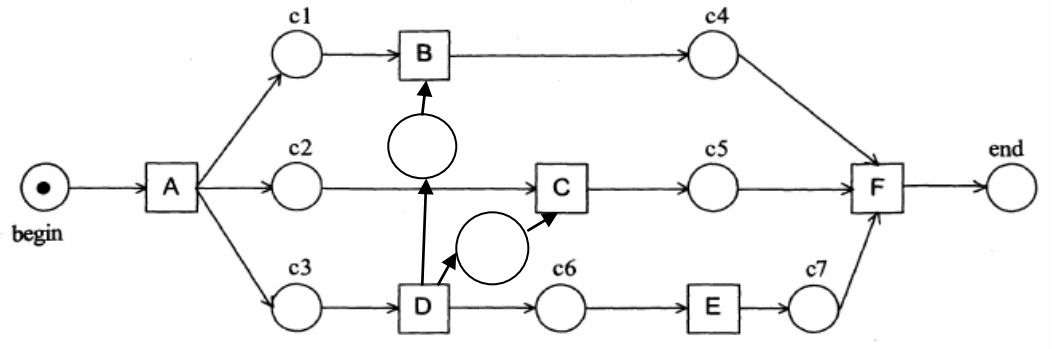
2） 修改所建模型使 B 和 C 在 D 后执行。（5 分）

答案：

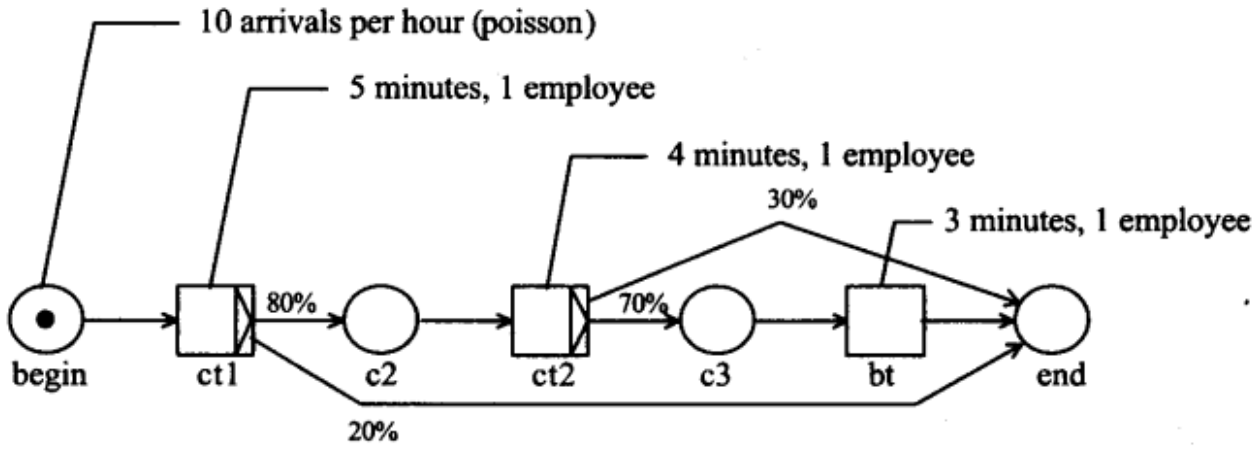
1）



2）



2. 如图所示过程。ctl 和 ctZ 是检查任务，如果它们是肯定的，任务 bt(如：保险赔付)被执行。如果其中一个是否定的，任务 bt 就被跳过，两个检查互相独立。



1）确定下面的性能指标：（8 分）

- 每个资源的占有率（利用率）
- 平均 WIP（正在执行的工作）
- 平均流动时间（完成时间）
- 每个任务的平均等待时间

2）给出一种过程定义的改进方案，并回答下列问题（7 分）

- 它好在哪里?
- 资源利用率多少?

参考答案：

1）

(a) ct1: (% = 1.0)

$\lambda = 10$	$\rho = 0.833$	S = 0.5
$\mu = 12$	L = 5	W = 0.04167

ct2: (% = 0.8)

$\lambda = 8$	$\rho = 0.533$	S = 0.143
$\mu = 15$	L = 1.14	W = 0.076

bt: (% = 0.56)

$\lambda = 5.6$	$\rho = 0.28$	S = 0.0694
$\mu = 20$	L = 0.389	W = 0.0194

Total: L^T

= 6.53

$S^T = 1 * 0.5 + 0.8 * 0.143 + 0.56 * 0.0694 = 0.5 + 0.114 + 0.0389 = 0.65$ (39.2 minutes)

(b) Alternative 1:

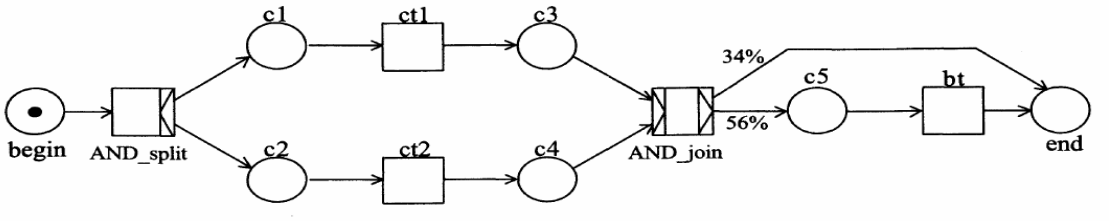


Figure S4.6
Alternative 1

It is possible to reduce flow time by executing things in parallel.

ct1: (% = 1.0)

$\lambda = 10$	$\rho = 0.833$	S = 0.5
$\mu = 12$	L = 5	

ct2: (% = 1.0)

$\lambda = 10$	$\rho = 0.67$	S = 0.2
$\mu = 15$	L = 2	

bt: (% = 0.56)

$\lambda = 5.6$	$\rho = 0.28$	S = 0.07
$\mu = 20$	L = 0.389	

ct1 is the bottleneck in the parallel process.

Total:

$L^T > 5.39$

Maximal throughput $= \lambda * (1/\rho_{\text{bottleneck}}) = 10 * (1/0.833) = 12$

Alternative 2:

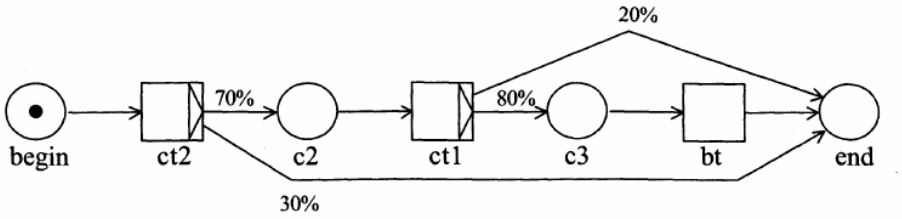


Figure S4.7
Alternative 2

In this case more tokens will go directly to end so the resources are used less.

ct1: (% = 0.7)

$\lambda = 7$ $\rho = 0.583$

$\mu = 12$ L = 1.4

ct2: (% = 1.0)

$\lambda = 10$ $\rho = 0.67$

$\mu = 15$ L = 2

bt: (% = 0.56)

$\lambda = 5.6$ $\rho = 0.28$

$\mu = 20$ L = 0.389

ct2 has now become the bottleneck and there are fewer cases in the system.

Total:

$L^T = 3.79$

Maximal throughput = $\lambda * (1/\rho_{bottleneck}) = 10 * (1/0.67) = 15$

Other alternatives:

- Combine *ct1* and *ct2* into one task to save setup time.
- Make one pool of resources available for all tasks.

3．分析传统工作流与 SOA 业务流程（服务组合）技术的优略，阐述它们融合的意义（15 分）。
答案要点：

传统工作流：支持人参与的业务流程（接口 2）；理论基础好，尤其是基于 Petri 网的建模及分析技术；互操作标准未得到工业界认同、集成能力差。
SOA 业务流程：不支持人参与的业务流程（接口 2）；理论基础较差；互操作及集成能力强，Web service、BPEL 成为工业标准；具有动态任务绑定能力（接口 3）

融合的意义：
1） 技术互补
2） 融合产品为基于互联网的跨组织协作提供了支持