Online Shopping*

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Abstract. The abstract should briefly summarize the contents of the paper in 15–250 words.

Keywords: First keyword · Second keyword · Another keyword.

1 Introduction

1.1 Overall Process Description

Online shopping is quickly integrated into our daily lives for the past decades. When deciding an item is necessary to be bought, increasingly more people decide to buy it through digital measures rather than a physical shop [reference]. In order to be able to buy a product online, the customer must first choose which website they would like to order from. After deciding on a website, the customer is able to either select a product category or view all products at once. The customer is then able to click on a product to access more information, and has the option whether or not to add it to their basket. The customer's shopping basket is displayed and the customer is able to delete items previously selected. When the customer has found the product(s) they are looking for, they can check-out their basket by creating or logging into their account. The customer must then confirm their name, phone number, shipping method and address. For shipping method, the customer will have the option of choosing between having their order delivered or for their order to be available for pick-up. The system then checks the availability of the item(s) the customer has added to their basket. After confirming the availability of the items, the customer will have the option of selecting a gift card and/or coupon, after which the total price will be updated. Then, the order will be paid and the payment will be confirmed. After this, the order will be confirmed and the customer has the option to cancel their order within 24 hours. If the customer decides to cancel their order, they will receive a confirmation email. If the customer does not cancel their order, the order will be shipped and the customer will receive tracking information. After either receiving a confirmation email or tracking information about their order, the customer is able to repeat the process of online shopping.

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1.2 Actors and Activities

The description should mention all participating actors and their activities, including a short motivation of the different activities and their role.

Participating actors are customers, since they buy products from digital platforms such as web shops. Online shopping platforms , such as web shops, are actors as well, and they are concerned with activities such as selling their product(s) and customer satisfaction.

Customers of a web shop would need to use the web shop for their motivation to buy a certain product. The web shop itself would have the motivation to make a profit, keep their existing customer base happy and potentially expand their business.

2 Transition System

2.1 Mathematical description of the transition system

A transition system is used to describe the behavior of a discrete system. It consists of a triple $(S, TR, s0)$ where S is the finite state space,

$$TR \subseteq S \times S \tag{1}$$

is the transition relation, and $s0$ is the initial state.

The mathematical notation of the online shopping process is formulated below.

$S = \{$website, prod_search_pg, category_pg, prod_display, do_not_add_to_basket, add_to_basket, basket, purchase_pg, login, details, phone, shipping, name, shipping_meth, give_address, verified, not_verified, item_avail, in_stock, out_of_stock, update_basket, discount_pg, coupon, gc, validate_coupon, validate_gc, update_price, ideal, bank_website, get_details, confirm_payment, cancellation, not_canceled, canceled, order_shipped, order_deleted, email$\}$

$TR = \{$(website, prod_search_pg), (prod_search_pg, category_pg), (prod_search_pg, prod_display), (prod_display, get_prod_information), (get_prod_information, do_not_add_to_basket), (get_prod_information, add_to_basket), (do_not_add_to_basket, basket), (add_to_basket, basket), (basket, website), (basket, purchase_pg), (purchase_pg, check_out), (check_out, login), (login, details), (details, shopping, phone, email), (give_address, name, phone), (not_verified, name, phone), (verified, name, phone), (verified, name, phone, item_avail), (item_avail, in_stock, out_of_stock), (in_stock, out_of_stock, update_basket), (update_basket, discount_pg), (discount_pg, coupon, gc), (validate_coupon, gc), (validate_gc, coupon), (validate_coupon, validate_gc), (validate_coupon, validate_gc, update_price), (update_price, ideal), (ideal, bank_website), (bank_website, get_details), (get_details, payment_confirmed), (payment_confirmed, cancellation), (cancellation, not_canceled), (not_canceled, order_shipped), (order_shipped, email), (cancellation, canceled), (canceled, order_deleted), (order_deleted, email), email, website), ... $\}$

2.2 State-transition diagram

A state-transition diagram was created for the specified transition system.

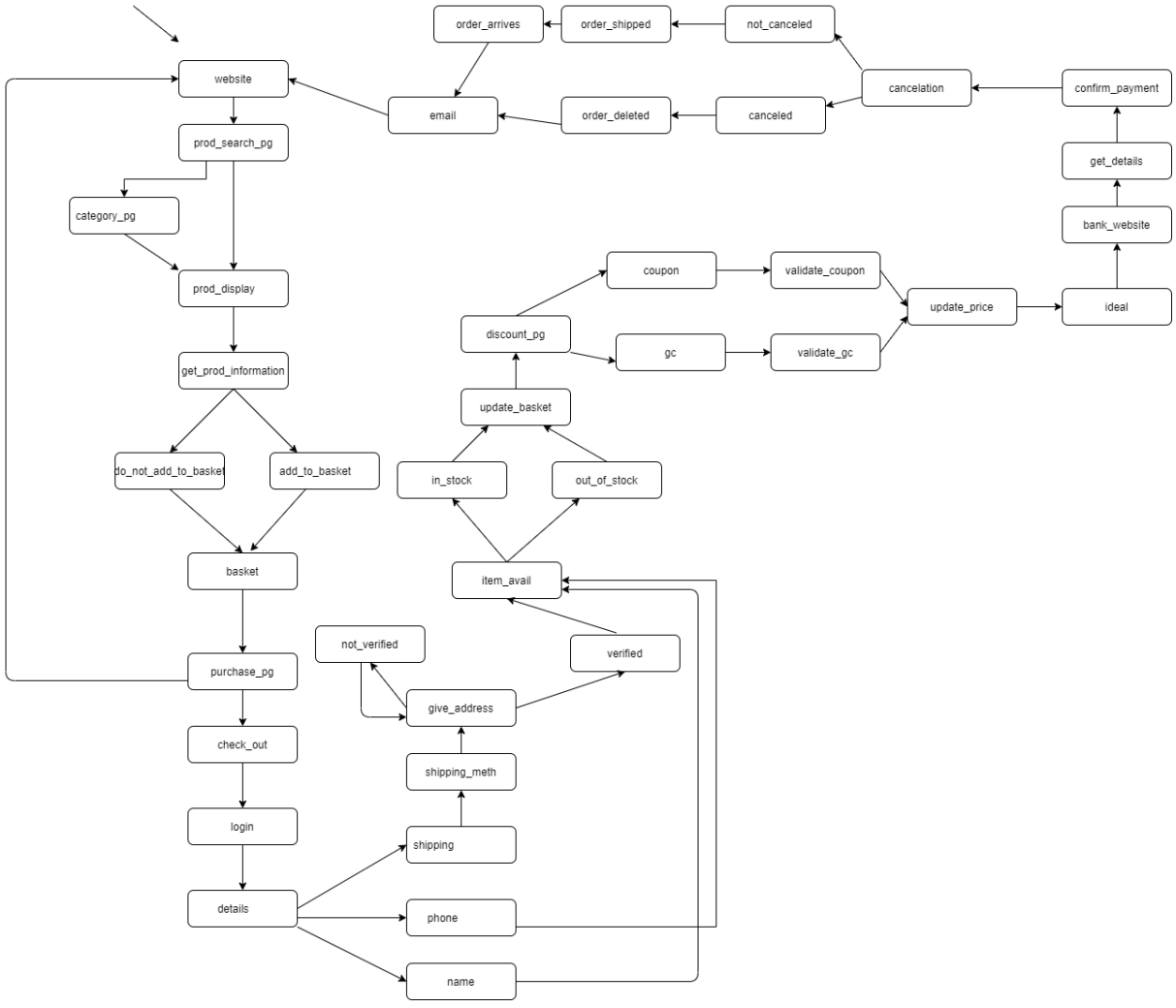

Fig. 1. State-transition diagram

3 Petri Net

A Petri net model is a graphical, yet mathematical diagram, that can be interpreted into a sort of map outlining how a system will process the information provided, in given situations followed up by the choices made by the user. With the use of Petri net models, it was possible to develop the derived concepts into real-life application, which in this case was the online shopping website. To create a logical Petri net model, online shopping websites were taken into consideration, such as Amazon, bol.com and Gmarket. Moreover, to shape a realistic model the details were given a lot of attention, resulting in creating a total of 34 places, 40 transitions and 99 arcs.

Places such as product_search_page, product_info_displayed, basket_update, basket, check_out_page, shipping_options_displayed and select_giftcard_were used as the join point of an XOR-split. The choice of this was given, in order to provide the choice between the two different transitions, thus this provides a choice to the user. The decision to use the XOR-split button was decided upon, in order to provide a method of choice to be modelled. As a result, the process will allow the token to be fired in the provided transition and emerge in the equivalent of the XOR-split, the XOR-join connected by transitions into a place.

There is a button that allows the processes to split into sub-processes and perform them in the same time, thus concurrently. This button is called the AND-split and was used in this model as the give_details, check_availability_item(s) and coupon_options_displayed_, giftcard_options_displayed_and payment_confirmed. This choice was made, because the token has to go through all the places, thus tracks, in order to enable all the sub-processes. Furthermore, because the tokens will be fired to all sub-processes, the equivalent of the AND-split, the AND-join is used to synchronize the point in time with the use of a transition as its emerging spot. Moreover, when looking at the transition before coupon_options_displayed, the transition above is a XOR-split button, thus it is also possible to have a AND-split within a XOR-split button as well as have a XOR-split button within a AND-split.

At transition transition_to_purchasing_website_it has been directed to the start place, which was a modelling choice made to iterate the whole process as an assumption that the shopping website would want their customers to look at more products and get comfortable with their website.

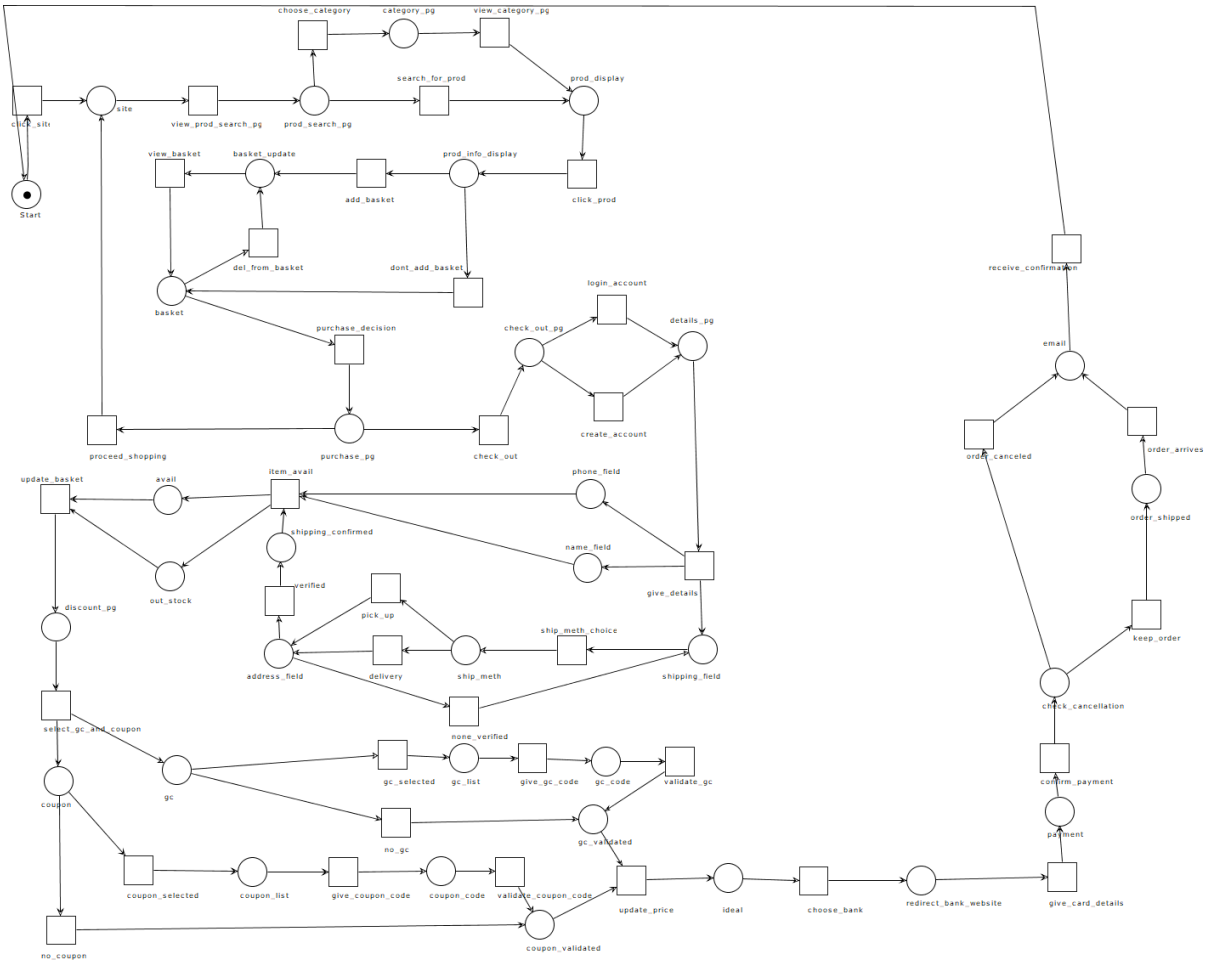

Fig. 2. Petri net of online shopping

4 Newest Petri Net version

This petri net [Figure 3] is not described as in the sections above, however, this is our most recent version of the petri net and would like feedback on it if possible. The code for this petri net is included in the zip as well.

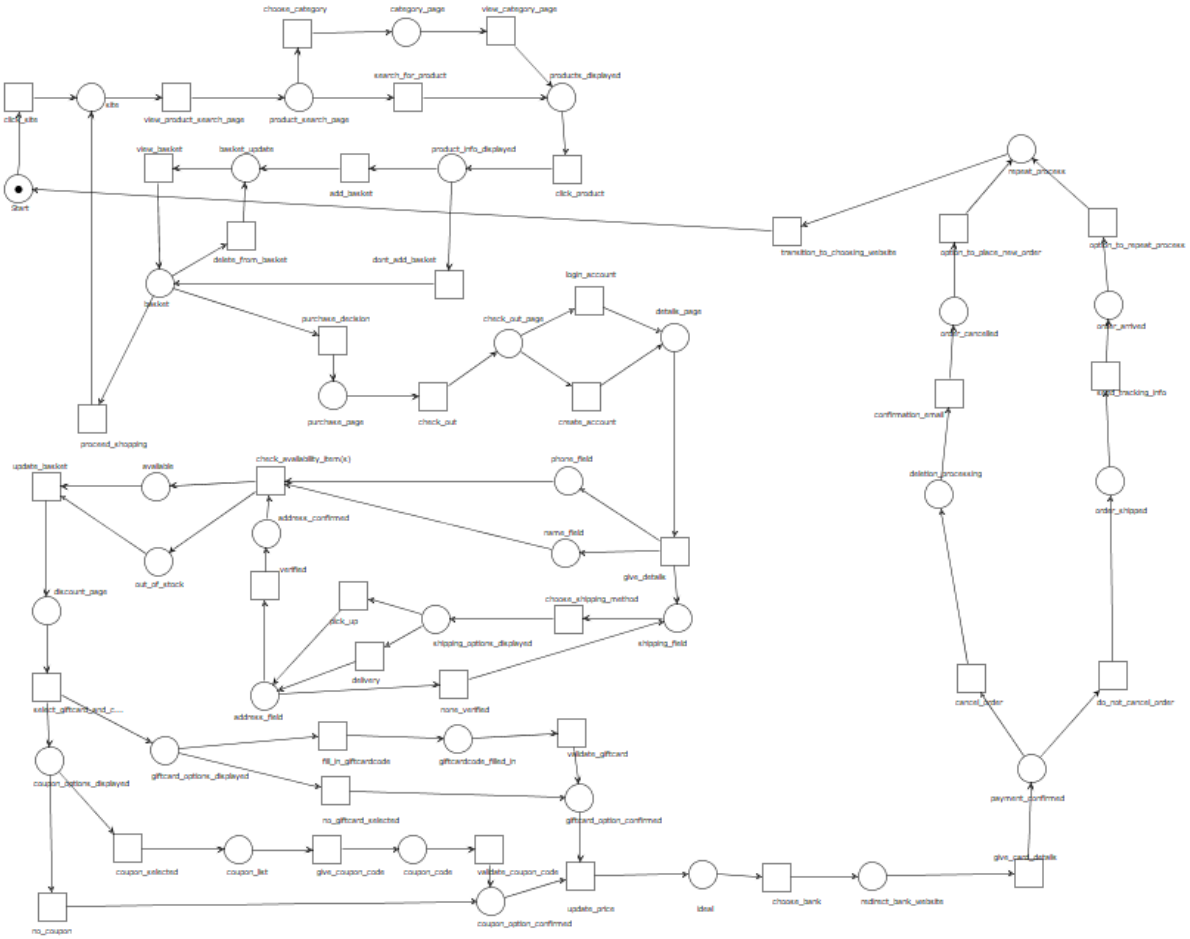

Fig. 3. New petri net version

5 Reachability graph

A reachability graph represents the reachable portion of the transition system. Our project group created a reachability graph that corresponds to the Petri net system [Figure 4]. In this reachability graph, states are represented within brackets as a multiset.

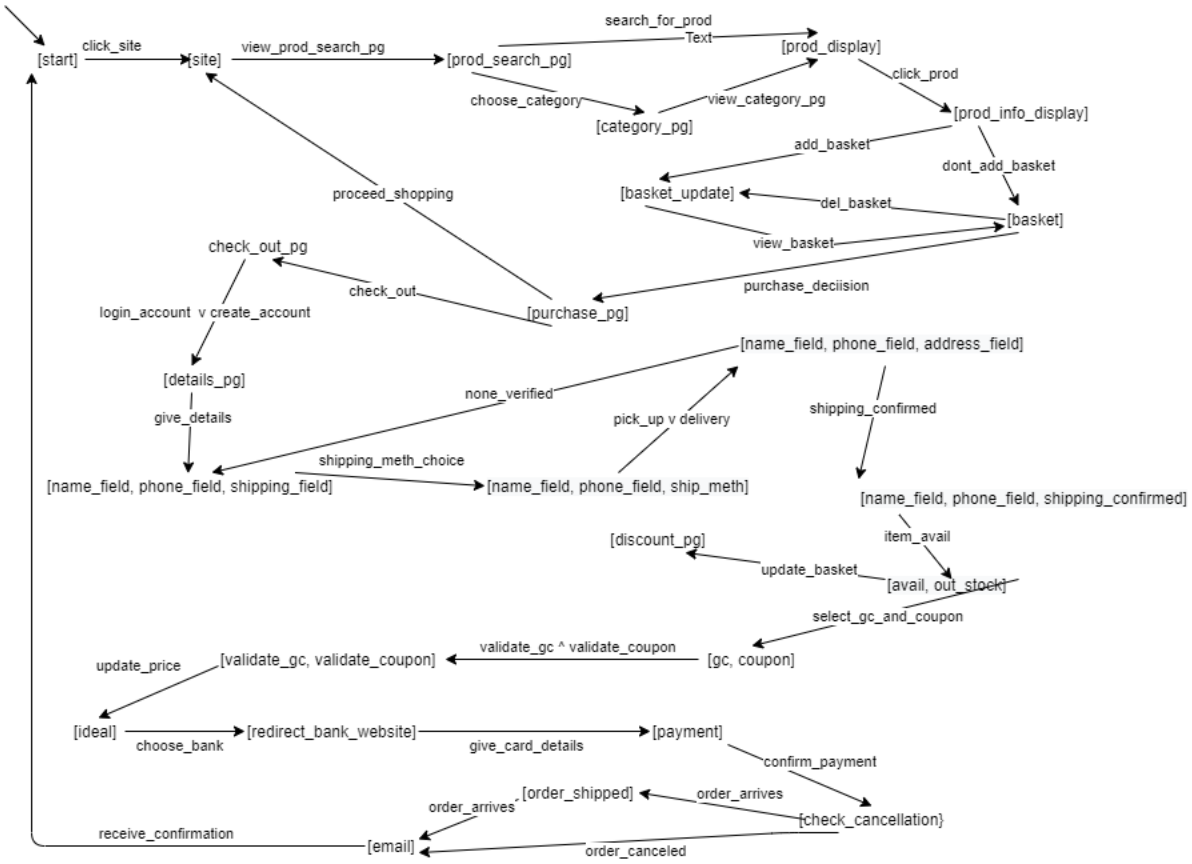

Fig. 4. Reachability graph

5.1 Analysis

Boundedness A Petri net is k-bounded if and only if no place in the transition system contains more than k tokens in any reachable marking. The reachability graph [Figure 4] is bounded; no reachable marking can contain more than 3 tokens.
Safety A Petri net is safe if and only if no place in the transition system contains more than 1 token in any reachable marking. The Petri net system is not safe as can be seen from the counter example where the marking [name_field, phone_field, shipping_field] consists of 3 tokens.
Termination A Petri net is terminating if every run is finite. The reachability graph is cyclic; therefore, the Petri net system is non-terminating. The Petri net has infinitely many runs.
Liveness A Petri net is live every transition can become enabled again. This entails that for every reachable marking m in the reachability graph, there is a marking m' reachable such that t is enabled at m'. Each transition can be re-enabled from every other marking in the diagram; thus, the Petri net system is live.
Deadlock freedomA Petri net is deadlock free if at least one transition is enabled at every reachable marking. The reachability graph is cyclic, which means that it at every reachable marking, a transition is enabled. Therefore, the Petri net is dead lock free.
Dead transitions A Petri net has a dead transition if it is not enabled at any reachable marking. Every transition that was implemented in the Petri net system, can enabled in the reachability graph. Hence, the Petri net system has no dead transitions.
Home markings A Petri net is home-marking if every marking can always be reached again. Our project group modeled online shopping as an iterative process; thus, all markings m can be reached again from any reachable marking. Consequently, the Petri net is home-marking.
Reversibility A Petri net is reversible if is capable to return to the initial state from any reachable marking. When a user shops online, it should be guaranteed that the user can go back to the previous stages from an internal step, and thereby ensuring reversibility. A user can return to the initial state from any reachable marking since the Petri net, including the initial state, is home-marking. Hence, the Petri net is reversible.

6 Reflection

You should include one or more reflection paragraphs where the advantages and limitations of the proposed models are discussed, as well as any key take-aways that were learned while performing the project. Finally, you need to include a paragraph where you explain how the work was split between the members of your group (who was responsible for what) and how you coordinated on the different tasks.

NOTE: the text below describes the model as we currently plan to implement it

advantages: the new Petri net is reversible, integrated extra's such as gift-card/coupon option, detailed model

disadvantages: only possible to resume shopping after viewing basket, an item out of stock or going through the entire process of paying and ordering. In our current model it is possible for the user to check out an empty basket, or to delete hypothetical items from an already empty basket. We make the assumption that this is unlikely to happen in real life, and therefore it remains part of our model. We also currently assume the payment will be successful each time.

Take-aways: even common processes such as online shopping require a lot of decision processes and actions, models often require assumptions in order to work.

7 Appendix

Yet to be filled in...

8 References

Yet to be filled in...