

## EIT Digital – Industrial PhD position proposal

### PhD thesis information

PhD Thesis – Title	<b>Constructive Recommendation Systems for Personalised Retail Solutions</b>
PhD Thesis – Short summary	<p>The aim of this PhD thesis is to make advancements in the application of machine learning and recommendation system techniques, in order to develop a new class of recommendation systems addressing the personalised construction of product/service bundle offers.</p> <p>The devised solution will advance the current state-of-the-art, being able to tackle the problem of building up (rather than choosing) the recommended “objects”, assembling them from building blocks. The system will incorporate trend information and revenue management aspects in order to maximise the benefits for the provider (by sustaining up-selling/cross-selling and increasing revenues) and for potential customers (in terms of overall satisfaction and savings).</p>
Rationale/challenge	<p>In modern retail, the capability to better address individual needs has become critical – both in terms of being able to provide the most appropriate set of pricing and product/service alternatives, and in terms of being able to flexibly intercept customised needs and offer a richer collection of services, while reducing the customer effort to engage different retailers/service providers to satisfy all her/his needs. This also affects the market of telco services, media and content provisioning, digital applications and devices.</p> <p>Recommendation systems often entered this scenario trying to build up-selling opportunities aligned with user purchasing history (profile) or their potential preferences (similarity with other users). In fact, most existing recommendation systems focus on identifying, among a set of candidates (e.g. products, media content, travel destinations, etc.), some solutions/items that a user may like. Traditional recommendation systems are based on: (i) how the features of the candidate items match the user model (content-based recommendation [1]), (ii) how similar users liked/chose the same candidate items (collaborative filtering [2]), or (iii) combinations of these basic approaches.</p> <p>This strategy is not optimal for two main reasons. First, choosing among a set of candidates assumes that at least one of the solutions available satisfies user needs. The second limitation of existing</p>

	<p>approaches is that they mostly focus on suggesting what a user is likely to be interested in now (from his history), possibly accounting for some diversification/novelty. However, in order to succeed on the market it is crucial to identify emerging needs, potential behavior changes and trends while driving the commercial strategies accordingly.</p>
<p>Innovation</p>	<p>The main innovation associated with this PhD thesis is the development of a new generation of recommendation systems, making larger use of data as a key element. In this way, we aim to design a specific recommendation system to be applied in the retail world, especially for product/service bundling (in order to create new up-selling and cross-selling opportunities).</p> <p>In particular, Constructive Recommendation is a new emerging branch of research in recommendation systems that is applied when the underlying assumption of most recommendation systems (i.e. the availability of an explicit set of items to choose from and a set of features to represent them) does not hold. One such case is when the recommendation task is constructive, i.e. the recommended items are "created" on the fly to satisfy the interest of the user, from a potentially extremely wide open set of combined objects (products, services, features, etc.). The possible constructive recommendation applications range from personalised shopping basket creation to automated travel planning systems. In particular, we aim to apply these solutions for TIM by way of the construction of personalised bundle offers which may include a wide range of services (such as personal or home communication plans), products (mobile devices, smart connected objects, ...) and applications (such as media content provisioning), increasing the overall satisfaction of the customer.</p> <p>The complexity of the problem is increased by the fact that the combination of objects must be controlled by a set of consistency constraints/criteria (such as compatibility of products, limits on pricing, etc.) and must be driven by the trends and opportunities identified by the analysis of the customers big data provided by TIM.</p>
<p>Research focus/topics</p>	<p>In this PhD the candidate will investigate the methodologies and develop solutions suitable for addressing the problems of the recommendation systems described above. The work will leverage a recently established collaboration between the DISI Department of the University of Trento and TIM (SKIL Joint Open Lab of Trento).</p> <p>The development of such an innovative constructive recommender system, capable of synthesising personalised bundle offers in an interactive fashion, requires the combination of: (i) an effective</p>

	<p>capability of learning and updating user preferences from heterogeneous data sources; (ii) the capability of driving the configuration and optimisation of the resulting offers on the basis of various types of hard and soft constraints (such as compatibility, pricing rules or revenue mechanisms for the company).</p> <p>Most of the previous work on recommendation systems has focused on integrating recommendation techniques into product configuration systems. In this context, collaborative filtering and other recommendation heuristics have been used, for instance, to recommend features or feature values at a given configuration step [3], [4]. In our research work the PhD will have to combine such state-of-the-art recommendation techniques with automated reasoning frameworks (such as constraint programming or SMT), in order to ensure a consistent combination of the basic element to construct the recommended solutions.</p> <p>Various preference elicitation strategies (such as regret-based elicitation [5], [6], and Bayesian preference elicitation [7], [8], [9]) should be taken in consideration and extended for the scenario of this research activity, in order to cope with the requirements imposed by the purchasing task, including the occasional inconsistencies of user feedbacks (typical of a human decision processes) and the challenging performance constraints necessary to ensure a proper user interaction and experience.</p> <p>A key aspect in evaluating the quality of the proposed research activity will be an extensive comparison of the developed approaches with the existing regret-based and Bayesian elicitation solutions in addition to experiments on the field with real potential customers.</p>
Expected outcome	<p>This PhD thesis will extend the research line in Constructive Recommendation Systems and deliver innovative recommendation system prototypes in the domains of interest for TIM, to be applied by TIM in its blended (physical and online) B2C retail channels.</p> <p>The system will be enhanced by the integration of patterns and trends (in terms of groups of users with emerging needs or new behaviors) resulting from the analytics of the company's big datasets (such as apps/service usages and demand, product trends, evolution of the communication traffic, etc.), to drive the evolution of the suggested offers.</p>
EIT Digital Action Line	Digital Industry

## Partnership

Industrial partner	<a href="#">TIM S.p.A.</a> (Telecom)
Academic/Research partner	<a href="#">University of Trento – UNITN (Italy)</a>
HEI granting the title	<a href="#">ICT International Doctoral School – University of Trento</a>
DTC location	Trento
PhD duration	3 years

## References

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