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# Tailoring Access to Content

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## Introduction and Motivation

Supporting users in searching and exploring large volumes of content presents significant challenges, particularly when different users have different and evolving needs. Content itself can be in a variety of different forms, text, image, and video. Moreover, several additional models and content forms may be extracted from an original content collection. In the case of historic manuscript collections, for example, there can exist a wide range of content forms and extracted models, including high-quality scans, manual transcriptions, manually written metadata, automatically generated normalizations, automatically extracted entity models (people, places, events), and social-network graphs of the persons mentioned. An example of such a collection is the *1641 Depositions*, a corpus of over 8000 handwritten manuscripts detailing the 1641 Rebellion in Ireland (<http://1641.tcd.ie>). The recent growth in digitization projects has resulted in the proliferation of digital archives and heterogeneous content collections.<sup>1</sup> For example, the Early English Books Online (EEBO) project presents a large collection of digitized material online (<http://eebo.chadwyck.com>). EEBO collects together more than 125,000 titles, but many of these titles are only offered as digital images of the individual pages. For these titles the words are not searchable, as the text has not been extracted from them. This extraction is often a costly and time-consuming process, as modern optical character recognition (OCR) techniques that scan images of text to extract words work best on modern fonts.

This chapter will present a variety of techniques and technologies that may be used to support tailored access to content in its wide variety of forms. This includes an introduction to the continuum of personalization, which strives to tailor how this wide range

of content is presented to meet the needs of individual users. It will also examine the applicability of different personalization techniques for different user groups and highlight how users may be offered increasing levels of control over this personalization.

The interdisciplinary field of digital humanities offers compelling opportunities for the application of personalization. It sits at the intersection of information and communications technology (ICT), knowledge management (which seeks to support the discovery and management of content in a structured manner), and a wide range of humanities disciplines. These disciplines have research practices which tend to be very labor-intensive, solitary, and characterized by research material which is often disconnected and non-digitized. This has presented a particular obstacle to novice researchers and to appreciation by the general public, as access to content is often a significant barrier. Digitization represents an important step forward, but the requirement remains for specialist environments which can offer a rich, personalized, and stimulating engagement with the digitized material to empower users with different backgrounds and experiences to interact with such collections.

Personalization and adaptive contextualization technologies such as adaptive hypermedia, adaptive web, intelligent systems, and recommendation systems have been successful in many application areas such as education, tourism, and general information sites. Personalization attempts to ensure that content and services are tailored to individual users' personal preferences, goals, and context while at the same time making the reuse of such media easier. Brusilovsky, one of the early innovators in the area of adaptive hypermedia (Brusilovsky, 2007), described some fundamental considerations for adaptive systems (Brusilovsky, 1996). De Bra was also instrumental in the creation of the early adaptive hypermedia systems with the development of *AHA!* (De Bra and Calvi, 1997). Recent research in adaptive hypermedia has sought to weave together content and interactive services to deliver personalized experiences (Conlan *et al.*, 2013). Such adaptive technologies reconcile each user's interests, prior experience, or location to provide personalized navigations of relevant digital resources (adaptive personalization) or suggest personalized recommendations concerning digital resources of interest based on similar users' behavior and feedback (social recommendation). These types of systems build an inferred model of users' interests by examining their interactions with the system. For example, if a user browses and bookmarks many documents about a particular person it may be inferred (possibly with a low confidence) that the user is currently interested in that person. If someone creates an annotation over a discrete piece of a document that contains a mention of that person the confidence may be increased. Such implicit modeling may be augmented with explicit modeling, i.e., taking direct guidance from the user, to adjust confidence levels and to add/remove items from the user's model. This evolving model of the user is used to adjust how the systems present information or make recommendations, with the systems attempting to prioritise content that will be of value to the user.

The rise of "i," "me," and "my" prefixes for various web portals (e.g., iGoogle, which transitioned to be the main Google search interface) and web services is intended to give the impression of some form of personal adaptation of content and service to an individual user's needs, preferences, or history to enhance the individual's experience. Typically however, such services tend to focus on (a) identification and ranking of relevant content (web pages) or services (Teevan *et al.*, 2005; Agichtein *et al.*, 2006;

Dou *et al.*, 2007); (b) simplistic “personalization” of the content presentation by inclusion of the user’s name and historical information/recently used resources; or (c) simple augmentation of screen layout (Ankolekar *et al.*, 2008). However, typical adaptive personalization technologies have three general weaknesses:

- They fail to take into account the broader community of which the user is a member, thus neglecting a valuable source of insight into user intention.
- They also fail to personalize in response to a sufficiently broad diversity of criteria, e.g., user intent (based on context of use) or level of user interaction control.
- They are unaware of the structure and internal dynamics of the material to which they offer access. Such “domain awareness” is an important input to the selection and sequencing of material presented by an adaptive system to the user.

These are all areas in which research in the field of digital humanities can offer insight and guidance. Recent large-scale digitization initiatives have made many important cultural heritage collections available online. This makes them accessible to the global research community and interested public for the first time. However, the full value of these heritage treasures is not being realized. After digitization, these collections are typically monolithic and difficult to navigate, and they can contain text which is of variable quality in terms of language, spelling, punctuation, and consistency of terminology and naming. As a result, they often fail to attract and sustain broad user engagement and so have only limited communities of interest. If such collections were augmented with personalized access they might become more accessible, thus unlocking their huge potential.

This chapter addresses the challenges associated with effectively empowering communities of researchers with personalized mechanisms which support their exploration, interrogation, and interpretation of complex digital cultural artifacts. A number of use-cases are presented to exemplify how these challenges may be addressed. Achieving balance between open exploration and personalized recommendation presents the most significant challenge, as offering just automated adaptivity is not enough. The danger of heavy-handed personalization is that users are presented with a highly prescriptive portal through which they interact with content, and that the portal filters content in a restrictive or biased fashion. This does not typically fit with the hypothesis building and research processes found in many humanities disciplines. Ensuring that the user is in control of the personalization process is essential to the success of explorative environments. Such user-centered control may be enhanced through: correlating usage patterns with self-expressed user goals; predefined research strategies; and the provision of appropriate tools for users to explore and navigate large cultural heritage information spaces. For example, personalization systems should empower their users to examine and control what the system has modeled about their interests, thus offering as much control as possible to generate the most appropriate and engaging experience for the user.

Next-generation adaptive systems aim to make digital humanities artifacts more appealing and more usable to a broader public, as well as supporting the activities of professional researchers. This will lead to larger and more active communities of interest focused on the artifacts. Such communities are key not only to sustaining interest in our heritage but also to promoting deeper understanding of, and contribution to, digital

humanities artifacts. Such communities can form the basis for sustained and richly rewarding engagement with digital humanities artifacts.

Innovative personalization can be achieved by taking into account a range of variables, such as individual user intent and diversity of use, awareness of the activities and interests of the community to which the user belongs, and in-depth analysis of the structure and features of digital humanities artifacts and collections. The following sections of this chapter discuss the key aspects that are needed to effectively tailor access to content. First, the importance of understanding each individual user, including that person's short- and long-term interests, is discussed. This is balanced with the need to give users control over how an adaptive environment models them and adapts to their needs. The following section then describes how personalization may be achieved by adapting elements of an environment. This section includes a discussion of how personalization may be introduced without limiting how a user may explore artifacts. The chapter then concludes with a discussion of some of the opportunities that this form of tailored access to content offers for the future.

## Users and Content

**Overview:** It is not possible for a computing system to really know and understand a person! Therefore, personalization systems need a model of both the individual and the content of interest, in order to make algorithmic decisions on how to best support that individual.

A wide variety of personalization techniques may be deployed to promote individualized access to content. For example, personalization techniques which offer high-level overviews of the themes within a collection may be more suited to the general public, whereas researchers who are intimately familiar with a content collection and the context in which it may be interpreted can gain more value from on-the-side guidance and connections to related resources. When developing an environment that aims to give access to content, it is essential that potential end users and key user communities be identified from the outset. If an environment is being designed to give tailored access to content via adaptive technology, then a range of user communities need to be addressed, potentially ranging from members of the general public – perhaps encountering the specific content collections for the first time – to experienced professional researchers. This presents a difficult challenge, as each individual user may wish to engage with this content in a variety of different ways. However, this is the challenge personalization techniques are designed to address.

Users vary in terms of their prior knowledge, experience with a collection, and the goals they wish to achieve. In this sense there exists a continuum of experience to which users belong. While it could be conveniently assumed that a member of the general public has less experience than a professional researcher, this is not strictly the case. For example, professional researchers may have specific artifacts or themes in a collection that focus their interest, whereas a general user may be bringing a lot of informal knowledge about the collection. There is another dimension of experience, beyond knowledge of the content, which should be considered. Users will also have varying experience of how to make effective use of the tools offered in an environment

to meet their needs. This stems both from general technical literacy/confidence and from specific experience using such tools. This aspect of experience can have a significant bearing on how the user approaches individual tasks.

In order to successfully model the user, it is important to have deeper information about the content and artifacts that user is working with. This information, such as the entities mentioned within a text, can be used to augment the user's model. For example, if the user navigates to several documents about the same person, an interest in that person may be implicitly assumed. There are a number of challenges with this approach: the first lies in successfully identifying the entities that are relevant to an artifact; the next comes from trying to determine a user's degree of interest in an artifact; and the third lies in ensuring the user has appropriate control over the user model, to scrutinize and control what has been modeled.

### *Content Modeling*

Overview: It is difficult or often impossible for computer systems to "understand" content. An abstracted model of the content, often referred to as metadata, is required to allow personalized systems to work with content.

Modeling the key characteristics in a piece of content is a necessary step if content is to be recommended to users and used to help determine their evolving interests. This modeling may take different forms, but typically it involves trying to identify the characteristics which may be pertinent to the users exploring the content. At a basic level, this may include simple entities such as people, places, and events. Even at this basic level issues may arise in ensuring the entities are accurately identified within the artifact. For example, anaphora resolution may require interpretation, either by a human annotator or from a piece of software to appropriately identify an entity. Specifically named entities in a piece of content tend to be easier to model and make explicit in the metadata describing the artifact.

The goal of modeling content, whether performed manually or with a (semi-) automated process, is to create a metadata representation of the document. This acts as a surrogate representation of the document and highlights the key entities related to the document. Ideally, these entities should be objectively verifiable and easily verified. If feasible, the entities should also be tied to different pieces of the artifact. For example, if a person is mentioned in a piece of text it is valuable to identify where, via character offsets, that mention occurs. This abstracted view of an artifact will enable the user modeling features to correlate user activity around an artifact with entities that the user may potentially be interested in.

### *User Modeling*

Overview: Users vary in their experience, preferences, and abilities. For personalization systems to tailor experiences for each individual user, an abstracted model of that user is required.

Central to the adaptive services provided within any adaptive environment is the user model (Kobsa, 93). A model of each user is built silently as a user interacts with the system. All actions a user performs are recorded in order to build up detailed

information on each user. The user model is a key input in any adaptive strategy employed by an adaptive environment.

For example, there are a number of different user actions that result in user model updates. These include viewing, bookmarking, and annotating content; performing a search; interacting with visualizations; and clicking recommendations. Each action results in different weightings being applied to the relevant entities that are stored within the user model. The entities are identified by examining the specific piece of content that the user is interacting with. For instance, viewing a page that contains specific mention of an individual, results in a small increase to the weighting of that person within the user model. Other less passive actions receive greater increments. For example, viewing a visualization of a particular document increases the weighting of relevant entities by a higher margin, while bookmarking a page increases the weighting even further, as does creating a note or annotating specific entities within a document. The weightings associated with these actions can be easily adjusted up or down, and new actions added that also impact entity weightings within the user model. This flexibility is key in tailoring the user model correctly. An example of a user model that is constructed in this manner can be found in the *CULTURA* research environment (Bailey *et al.*, 2012).

It is important that a model of a user has some form of decay function that factors in how recently the user has shown interest in certain entities. For example, a user may show a lot of interest in a certain city in the early stages of exploring a collection, but may move on to more refined expression of interest in a locale as the exploration progresses. The weightings applied to the original entity should decay with time, or more precisely with interactions. It is also possible to maintain a variety of different models for a user that represent shorter- and longer-term interests. One approach is for an environment to maintain two models, one complete model that captures and decays all user actions and another that only captures a finite number of interactions. In this way different recommenders may be built to account for short-term versus long-term interest. Regardless of the modeling approach employed, it is important to give the user as much control as possible over the model, to allow it to be adjusted to meet each user's needs.

### *Transparency, Reflection, and User Control*

Overview: Sometimes computers get it wrong! Offering users an insight into what the personalization system has modeled about them and the ability to tweak and control that model is important to ensure the system behaves as they wish.

Often users are curious as to why specific recommendations are being made to them, but they generally have no way of seeing the model of interest representing them in the background. This may be tackled in two ways.

Firstly, when recommendations are made to a user, an explanation should be provided as to why they are being presented. For instance, in *CULTURA* recommendations are accompanied by explanatory text indicating that links are relevant to an entity (person, place, event, etc.) that the user has encountered in their explorations. In Figure 12.1 the items in each list link to resources that are related to the place entities “Lismore,” “Trim,” and “Meath.” This box is rendered beside the deposition text and enables users to quickly locate new resources that may be relevant to their

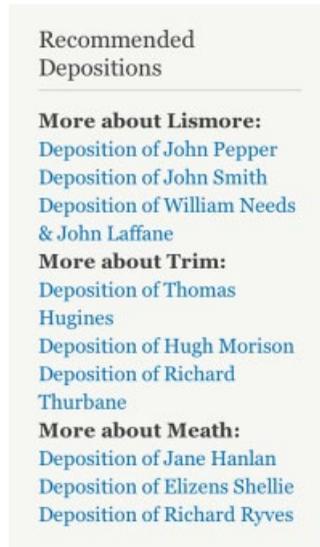


Figure 12.1 Personalized recommendations based on user interests.



Figure 12.2 User model rendered as a tag cloud.

exploration and interests. The box indicates why these resources are being recommended to them. In this way, it is clear why the recommendations are there, even if the user does not necessarily agree on their relevance (Hampson *et al.*, 2014).

This potential disagreement resonates with a second feature that an adaptive environment should offer: a mechanism to display the entities that are having most influence on a user's model. One mechanism for manifesting such information is to use a tag cloud. This is used to promote reflection and to allow the user to understand and manipulate the model. Importantly, the tag cloud is not static, and a user can adjust the relative influence of various entities through the interface offered (Figure 12.2). For example, if there are a number of terms that the system thinks are of interest to the user in the current context, but which the user disagrees with, then it is easy to select the terms and either delete them entirely or reduce their individual sizes in the tag cloud. In addition, the user can add new terms manually, or increase the size of entities within the model. Any change in an entity's size has a direct impact on the

recommendation calculations that occur when the user resumes browsing a content collection. This process makes the automatic processing that is occurring in the background more transparent, in addition to giving users significant control over how their user models represent them. Different clouds can be rendered for different types of entities (people, organizations, etc.) as well as different clouds detailing the user's overall model of interest and current short-term model of interest.

## Personalization and Adaptivity

Overview: The user and content models alone are not enough to generate a tailored experience. The personalization systems need some algorithms and logic to decide how best to support the user.

Personalization techniques and technologies offer the promise of tailoring each user's access to content in response to that individual's information need, knowledge, preferences, and so on. These techniques support a continuum of engagement with content, ranging from highly prescriptive offerings based upon a model of each user's behavior to less constrained, user-centric curation of content collections, for a spectrum of user categories. A four-phase model of personalization has been proposed to support this continuum of engagement and to allow users to move seamlessly between a constrained, guided navigation and more freeform, open exploration of a content collection (Hampson *et al.*, 2014).

### *Four-Phase Model of Personalization*

Overview: There are many approaches to personalizing user experiences, but few are tailored for the forms of exploration performed by humanities scholars. The four-phase model presented in this section provides flexible mechanisms for enabling personalized experiences over a wide variety of content.

One reason why novice users struggle to engage with large cultural collections is a lack of guidance when they initially encounter the set of resources. The four-phase personalization approach has been designed to counteract this by providing a structured introductory pathway into a collection, without restricting users from exploring the material as their interest is piqued. The four phases defined by the approach are *guide*, *explore*, *suggest*, and *reflect*.

Users with little experience of the content typically start their investigations within the *guide* phase. Here a "narrative" is employed, which enables resources within a collection to be sequenced on a specific theme (e.g., the evolution of a form of illumination in fifteenth-century Padua; Agosti *et al.*, 2013). Furthermore, how these resources are rendered to the user (text, visualization, etc.) can also be specified within the narrative metadata, which is encoded as XML. This process is especially useful for providing users with a path through specific content, though it does not limit their ability to use these sequenced narratives as a springboard for their own investigations. Within the four-phase personalization approach, this involves stepping from the *guide* phase to the *explore* phase (number 1 in Figure 12.3). Narrative pathways are discussed in more detail in the next section.

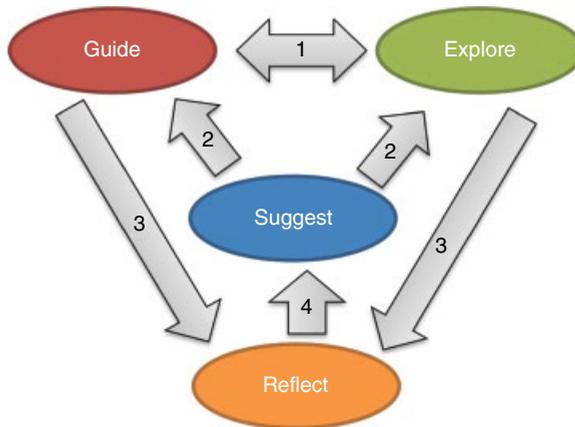


Figure 12.3 The four-phase approach to personalization.

In the *explore* phase, tools are offered to support the exploration and browsing of the underlying content collections. These tools can include data-enriched maps, entity-oriented search, social-network analysis and visualization, amongst many others. At any stage users can return to where they left their path in the *guide* phase, and users with little prior knowledge of the resources often flick between the *explore* and *guide* phases several times. In contrast, professional researchers with a deep understanding of the collection typically spend the majority of their time within the *explore* phase, and may never involve themselves with the more structured *guide* phase.

Importantly, by monitoring the user model as a user explores the content, the narrative path presented in the *guide* phase can be adapted by the system. This is achieved by selecting documents for the user's path that most closely match that user's interests or information needs. This can result in the path being enriched with further resources, exploration points, and concepts.

Whether within the *guide* or *explore* phase, a user will be given personalized suggestions for content, or tools which offer exploration points. These suggestions are based upon the system's interpretation of the user's actions and interests, as manifest in the user model. This process occurs in the *suggest* phase (which works in parallel with the *guide* and *explore* phases), with on-the-side, noninvasive recommendations presented to users (number 2 in Figure 12.3). These recommendations are influenced by both long- and short-term interests of the user as indicated by the user's actions – search terms submitted, entities viewed, annotations created, and so on.

At any stage within the *guide* or *explore* phases, users may enter the *reflect* phase. This involves viewing their user model and seeing what interests the environment has associated with them (number 3 in Figure 12.3). The *reflect* phase is not static, and users can edit their user model. They can add or delete terms, or manually increase or reduce the size of existing terms (thus changing their degree of influence). Importantly, any changes made during the *reflect* phase directly impacts upon the *suggest* phase and the recommendations that eventually filter down into the *guide* and *explore* phases (number 4 in Figure 12.3).

By espousing the four-phase personalization approach, digital humanities environments can dynamically adapt to users, support the various ways in which they wish to

engage with a content collection, and render useful suggestions to them at appropriate times. Moreover, this process provides mechanisms that are appropriate for a range of users with different levels of ability or different interests in the underlying resources.

### *Narrative*

Overview: Inexperienced users can often find it daunting when confronted with a large collection of artifacts. Narratives provide flexible guided pathways across artifacts to gently introduce the user to the content available.

In personalized systems, a narrative represents a navigation structure based upon relationships between concepts in a domain (Conlan *et al.*, 2013). This navigation structure is designed to meet an objective, such as providing a guided introduction to a topic in a content collection. At design time this strategy is authored to represent the variety of potential conceptual pathways that can be used to generate a user experience. During execution, these potential pathways are reconciled with the user model to select the most appropriate or relevant for that individual. Each step on this pathway can be a piece of content, or a service such as a network visualization or entity-oriented search.

When using an environment designed using the four-phase approach to personalization, users with little experience of a content collection will typically start their investigations within the *guide* phase via a narrative module. This “narrative” module, which in the example in Figure 12.4 is rendered to users as a lesson block within the

Lesson Block

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**What happened in Drogheda on the outbreak of rebellion?**

As the rebellion took hold in the North of Ireland, the colonial authorities scrambled to gather adequate forces for the defence of the colony. A key victory occurred with the successful repulsion of the rebel siege at Drogheda. What does William Fitzgerald reveal about the siege at Drogheda

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Figure 12.4 A guided lesson plan.

user interface, enables resources within the collection to be sequenced on a specific theme, such as a chain of derivation of illustrations in an illuminated manuscript collection, or the reliability of witness statements in a collection of depositions.

These lessons are developed by domain experts, and they contain paths of various lengths (with optional and compulsory parts), so that users with different levels of interest can be accommodated. Furthermore, how these resources are rendered to the user (text, visualization, etc.) can also be specified within the narrative.

As described above, being on a guided path does not limit the more adventurous user from exploring the collection in a more freeform manner by using the services offered as part of the explore phase. In fact, many narratives explicitly encourage users to do so, by including services in the narrative which can be a springboard for the user's own investigations.

Personalized environments can monitor a user's progress through a narrative, and if the user shows sufficient interest in particular concepts, the narrative can be dynamically augmented through the addition of further relevant resources. Importantly, users can also explicitly adjust narratives as they make progress (by choosing to see more resources on a specific concept), which gives them ultimate control of their experience.

### *Personalized Search*

Overview: Searching online is a very familiar process for most users. However, for a given query, offering the same set of results to every user does not account for their individual differences. Personalized search uses the user model to tailor the results for each user.

Unprecedented amounts of digital humanities content is now available online, in digital libraries, repositories, and archives. This information is available in many formats, and offers wonderful opportunities for knowledge discovery, but also presents many complex challenges for the discovery, combination, and exploration of appropriate information from disparate sources.

Personalizing the process of searching for information online has been demonstrated to be a very effective method of supporting users in the navigation of these increasingly large volumes of content. Personalized search attempts to deliver customized results to meet specific user interests, preferences, information needs, and contexts (Micarelli *et al.*, 2007; Zhou *et al.*, 2012). This is achieved by using information about a user to adapt the content selected and presented to that user's needs, preferences, knowledge, and interests, and to automatically resolve potential ambiguity in searches. As described above, providing users with some control over these user models and how the personalization process influences the search is key to ensuring satisfaction and promoting adoption (Ahn *et al.*, 2008).

When using a search interface to explore and investigate a cultural heritage collection, users' information needs are continuously evolving as they acquire knowledge and gain context. As a result, an individual's perception of the relevance of a piece of content will also continuously change. Relevance, which was traditionally viewed as a static state in search systems, must now be considered more fluid and adaptive.

### *Recommendation*

Overview: One potential problem with exploring collections online is that a user who does not search for a particular piece of content may never become aware of it. Recommendation enables personalization systems to highlight content that is relevant to the user's activities and interests.

Recommendation is an approach to information filtering which attempts to identify content that is likely to be of interest to an individual user. Recommendation is usually achieved by analyzing the content of a collection and matching items from that collection to a user model (Ricci *et al.*, 2011). We have already discussed how such user models are constructed based upon a user's previous actions. Another approach to recommendation is known as collaborative filtering (Resnick *et al.*, 1994), where the system attempts to predict what content a user will find relevant based upon that user's similarity to other users.

An example of how collaborative filtering can be used is the recommenders developed by the *CULTURA* project (<http://www.cultura-strep.eu>). In this approach, two distinct sets of recommendations are offered to users as they explore a cultural heritage collection. These recommendations are delivered by two tools, a "Hybrid Recommender" and a "Global Recommender." These tools implement the *suggest* phase of the four phase personalization approach.

The Hybrid Recommender generates a list of recommended content based upon an individual's user model and the content that the user is currently viewing. Specifically this involves looking at the entities extracted from each resource and blending them with respect to the weighted entities of interest stored within the user model. The Hybrid Recommender can also access the weighting between entities that have been a recent focus of interest to the user, as opposed to those terms that consistently appear to be of relevance to the user. After this analysis and blending of results takes place, links to relevant content are generated and rendered within a side block in the environment. This provides the user with a useful, noninvasive mechanism for further browsing of the cultural archive.

While the Hybrid Recommender takes into account the current content that the user is viewing and balances the entities contained within that content with those entities in the user model, the Global Recommender gives recommendations based solely on the individual's user model. This recommender is designed to provide initial starting points for exploration rather than providing links to complementary resources while in the middle of an exploration.

### **Conclusion**

This chapter has introduced some of the challenges encountered in offering tailored access to content. It has discussed how analyzing both the user's actions and the artifacts in a collection can yield a number of possibilities for generating a personalized experience. However, caution must be exercised in realizing these possibilities. Users should be supported in their explorations, and any personalization offered should be peripheral. The users interacting with collections of content have a variety of backgrounds and

different levels of experience. When tailoring access to these collections, all of these users should be effectively supported in the tasks they are trying to accomplish.

Any personalized solution offered should leave the user very much in control. The four-phase model for personalization allows seamless movement between guidance, exploration, suggestion, and reflection, thus empowering users to maximize their engagement with a content collection. Of key importance in this model is the reflection phase, which enables the user to scrutinize and adjust the user model, upon which personalization is based. Engaging in reflection not only allows this control, but can also help users to identify relevant topics and entities they were not explicitly aware of. The guidance phase enables novice users to receive directed support in navigating across key artifacts in a collection. This guidance is offered through narrative, a curated path and commentary linking a number of artifacts together. Again, this guidance is offered alongside the artifacts, so that users can engage in exploration whenever they choose. The key point when offering personalized experiences is that users should be empowered to follow their interests and explore the content as they wish, with the personalized recommendations, narratives, and search offering appropriate support along the way.

#### NOTE

- 1 Further examples of such collections are: The Old Bailey Online (<http://www.oldbaileyonline.org>); Google Library Archives (<http://www.google.com/googlebooks/partners.html>); Eighteenth Century Collections Online (<http://find.galegroup.com/ecco/start.do?prodId=ECCO&userGroupName=tcd>); BHL-Europe (<http://www.bhl-europe.eu>).

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