

Others Symbols,

Additional characters proposed to Unicode

Azzeddine LAZREK

lazrek@ucam.ac.ma

Cadi Ayyad University, Faculty of Sciences

P.O. Box 2390, Marrakech, Morocco

Phone: +212 44 43 46 49 Fax: +212 44 43 74 09

URL: <http://www.ucam.ac.ma/fssm/rydarab>

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Abstract

Here are gathered the symbols which are not accepted for inclusion to the Unicode Standard during the discussions.

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1 Mirrored symbols

The majority of symbols used in Arabic mathematical presentation are the mirrored corresponding used in Latin presentation. Some symbols and there mirrored one are used together in Latin presentation [5] [3].

In the Unicode Standard, there is the mirrored propriety for some characters [4]. Then, characters that have the mirrored property can be displayed, through an available font and rendering engine, with a mirrored image in right-to-left text runs [1].

1.1 Frequently used symbols

In Arabic Mathematical notation [2], they are some frequently used Arabic symbols that have appropriate mirrored characters in the Unicode Standard (see Table 1). As, the number of those characters is not very important, many characters and their mirrored (e.g., $<$ and $>$) are already both encoded and the presence of some names ambiguity, we propose them for addition to the Unicode Standard. That allows to obtained them directly.

⌋	REVERSED COMPLEMENT \approx \langle reversed \rangle 2201 ⌋
⌋	REVERSED PARTIAL DIFFERENTIAL \approx \langle reversed \rangle 2202 ⌋
⌋	REVERSED THERE EXISTS \approx \langle reversed \rangle 2203 ⌋
⌋	REVERSED N-ARY SUMMARY \approx \langle reversed \rangle 2211 ⌋
⌋	REVERSED SQUARE ROOT \approx \langle reversed \rangle 221A ⌋
⌋	REVERSED RIGHT ANGLE \approx \langle reversed \rangle 221F ⌋
⌋	REVERSED ANGLE \approx \langle reversed \rangle 2220 ⌋
⌋	REVERSED MEASURED ANGLE \approx \langle reversed \rangle 2221 ⌋
⌋	REVERSED SPHERICAL ANGLE \approx \langle reversed \rangle 2222 ⌋
⌋	REVERSED INTEGRAL \approx \langle reversed \rangle 222B ⌋

Table 1: Frequently used symbols with appropriate mirrored image

1.2 Non frequently used symbols

The other symbols are not frequently in use. Of course, the corresponding regular character has the mirrored property, and then characters will be displayed with a mirrored image in right-to-left text runs (see example in Table 2).

$\int\int$	REVERSED DOUBLE INTEGRAL \approx <reversed> 222C $\int\int$
$\int\int\int$	REVERSED TRIPLE INTEGRAL \approx <reversed> 222D $\int\int\int$
\oint	REVERSED CONTOUR INTEGRAL \approx <reversed> 222E \oint

Table 2: Non frequently used symbols with appropriate mirrored image

1.3 Negated symbols

The slanted line for negation of operators is oriented in the Arabic mathematical presentation as it is for the Latin case. Care has to be taken in mirroring the negated symbols (see example in Table 3). In a similar way, the arrows in symbols like 2231 to 2233 are not mirrored as their orientation is not based on the writing direction, but on the direction in which the integration is applied.

\nexists	REVERSED THERE DOES NOT EXISTS \approx <reversed> 2204 \nexists
------------	--

Table 3: Negation symbol

2 Radix symbols with Arabic digits

The radix symbols with Arabic digits from Table 4 are used in Arabic mathematical context. While mathematical layout software can use markup to create radix symbols of any order, these two are common enough in general usage that explicit code points should be assigned. Consequently they are proposed for encoding here.

These characters should have general category Sm, neutral right-to-left directionality and should not mirror.

$\sqrt[3]{}$	REVERSED CUBE ROOT \approx <reversed> 221B $\sqrt[3]{}$
$\sqrt[4]{}$	REVERSED FOURTH ROOT \approx <reversed> 221C $\sqrt[4]{}$

Table 4: Mathematical symbols with no appropriate mirroring

3 Crescent

The crescent sign in the two direction (see Table 5) is proposed for encoding here.

This character should have general category So and have neutral directionality.

$\left($	LEFT CRESCENT
$\right)$	RIGHT CRESCENT

Table 5: Crescent sign

هـ	ARABIC HEJRY DATE
	≈ <isolated> 0647 هـ Arabic letter heh
	≈ 0647 هـ Arabic letter heh
	≈ 06BE هـ Arabic letter heh doachashmee
	≈ FEEB هـ Arabic letter heh initial form
م	ARABIC MYLADY DATE
	≈ <isolated> 0645 م Arabic letter meem
	≈ FEE1 م Arabic letter meem isolated form

Table 9: Dates marks

6 Units

The Arabic square unit, corresponding to the Latin square Km is marked with a special abbreviation كم. It represents an example of various signs for units that are worth of being included in the Unicode Standard (see Table 10).

كم	ARABIC SQUARE KM
	≈ <square>0643 كم 0645 م
	→ 339E square km

Table 10: Example of unit symbols

7 Arrows

The signs listed in the range U+2790-27FF don't include symmetrical signs oriented right-to-left. So, supplemental arrows in Dingbat arrows should be added even if that the majority of these characters is decorative. In particular, symmetrical signs for all symbols from 2794 to 27BE (see Table 11) are proposed with the specification LEFTWARDS, in contrast to RIGHTWARDS. Those characters need to be mirrored, but would not be mirrored in plain text since arrows don't have the Bidi Mirrored property in Unicode.

←	TRIANGLE-HEADED LEFTWARDS ARROW
◄	HEAVY TRIANGLE-HEADED LEFTWARDS ARROW

Table 11: Examples of needed arrows

8 Alphabetic symbols

The list of character of *Arabic mathematical alphabetic symbols*, already present in Unicode, proposed to be add into the Unicode Standard is presented below:

- Arabic mathematical isolated alphabetic symbols (see Table 12);
- Arabic mathematical initial alphabetic symbols (see Table 13);
- Arabic mathematical others alphabetic symbols (see Table 14).

From the Unicode and WG2 perspective, any proposal that contains shapes that appear identical to existing characters will not be easy. The problem with duplicating characters with identical shapes is that users will end up entering the wrong character and not be able to determine which is which by looking at the text. The kinds of overriding reasons that Unicode or WG2 would allow is very limited. The initial and isolated forms, as well as to some other characters, such as lam-alef, peh, the hamza and all the other characters from existing characters, used in mathematics are identical in appearance to the characters in the standard Arabic or the Presentation forms blocks. In particular, the presentation forms, are not supposed to be used as character codes for ordinary text. Ordinary text uses the codes for the abstract forms in the 0600 block exclusively, and any positional shapes are determined by the rendering engine. Therefore, not adding another set of mathematical presentation forms will not affect ordinary text users and it's much simpler.

ا	MATHEMATICAL ALEF ≈ 0627 Arabic letter alef
ب	MATHEMATICAL BEH ≈ 0628 ب Arabic letter beh
ج	MATHEMATICAL JEEM ≈ 062C ج Arabic letter jeem
د	MATHEMATICAL DAL ≈ 062F د Arabic letter dal
ه	MATHEMATICAL HEH ≈ 0647 ه Arabic letter heh
و	MATHEMATICAL WAW ≈ 0648 و Arabic letter waw
ز	MATHEMATICAL ZAIN ≈ 0632 ز Arabic letter zain
ح	MATHEMATICAL HAH ≈ 062D ح Arabic letter hah
ط	MATHEMATICAL TAH ≈ 0637 ط Arabic letter tah
ي	MATHEMATICAL YEH ≈ 064A ي Arabic letter yeh
ك	MATHEMATICAL KAF ≈ 0643 ك Arabic letter kaf
ل	MATHEMATICAL LAM ≈ 0644 ل Arabic letter lam
م	MATHEMATICAL MEEM ≈ 0645 م Arabic letter meem
ن	MATHEMATICAL NOON ≈ 0646 ن Arabic letter noon
س	MATHEMATICAL SEEN ≈ 0634 س Arabic letter seen
ع	MATHEMATICAL AIN ≈ 0639 ع Arabic letter ain
ف	MATHEMATICAL FEH ≈ 0641 ف Arabic letter feh
ص	MATHEMATICAL SAD ≈ 0635 ص Arabic letter sad
ق	MATHEMATICAL QAF ≈ 0642 ق Arabic letter qaf
ر	MATHEMATICAL REH ≈ 0631 ر Arabic letter reh
ش	MATHEMATICAL SHEEN ≈ 0634 ش Arabic letter sheen
ت	MATHEMATICAL TEH ≈ 062A ت Arabic letter teh
ث	MATHEMATICAL THEH ≈ 062B ث Arabic letter theh
خ	MATHEMATICAL KHAH ≈ 062E خ Arabic letter khah
ذ	MATHEMATICAL THAL ≈ 0630 ذ Arabic letter thal
ض	MATHEMATICAL DAD ≈ 0636 ض Arabic letter dad
ظ	MATHEMATICAL ZAH ≈ 0638 ظ Arabic letter zah
غ	MATHEMATICAL GHAIN ≈ 063A غ Arabic letter ghain

Table 12: Mathematical isolated alphabetic symbols









































ب	MATHEMATICAL BEH ≈ <initial> 0628  Arabic letter beh ≈ FE91  Arabic letter beh initial form
ج	MATHEMATICAL INITIAL JEEM ≈ <initial> 062C  Arabic letter jeem ≈ FE9F  Arabic letter jeem initial form
هـ	MATHEMATICAL INITIAL HEH ≈ <initial> 0647  Arabic letter heh ≈ FEEB  Arabic letter heh initial form
ح	MATHEMATICAL INITIAL HAH ≈ <initial> 062D  Arabic letter hah ≈ FEA3  Arabic letter hah initial form
يـ	MATHEMATICAL INITIAL YEH ≈ <initial> 064A  Arabic letter yeh ≈ FEF3  Arabic letter yeh initial form
ك	MATHEMATICAL INITIAL KAF ≈ <initial> 0643  Arabic letter kaf ≈ FEDB  Arabic letter kaf initial form
ل	MATHEMATICAL INITIAL LAM ≈ <initial> 0644  Arabic letter lam ≈ FEDF  Arabic letter lam initial form
م	MATHEMATICAL INITIAL MEEM ≈ <initial> 0645  Arabic letter meem ≈ FEE3  Arabic letter meem initial form
نـ	MATHEMATICAL INITIAL NOON ≈ <initial> 0646  Arabic letter noon ≈ FEE7  Arabic letter noon initial form
سـ	MATHEMATICAL INITIAL SEEN ≈ <initial> 0634  Arabic letter seen ≈ FEB3  Arabic letter seen initial form
عـ	MATHEMATICAL INITIAL AIN ≈ <initial> 0639  Arabic letter ain ≈ FECB  Arabic letter ain initial form
فـ	MATHEMATICAL INITIAL FEH ≈ <initial> 0641  Arabic letter feh ≈ FED3  Arabic letter feh initial form
صـ	MATHEMATICAL INITIAL SAD ≈ <initial> 0635  Arabic letter sad ≈ FEBB  Arabic letter sad initial form
قـ	MATHEMATICAL INITIAL QAF ≈ <initial> 0642  Arabic letter qaf ≈ FED7  Arabic letter qaf initial form
شـ	MATHEMATICAL INITIAL SHEEN ≈ <initial> 0634  Arabic letter sheen ≈ FEB7  Arabic letter sheen initial form
تـ	MATHEMATICAL INITIAL TEH ≈ <initial> 062A  Arabic letter teh ≈ FE97  Arabic letter teh initial form
ثـ	MATHEMATICAL INITIAL THEH ≈ <initial> 062B  Arabic letter theh ≈ FE9B  Arabic letter theh initial form
خـ	MATHEMATICAL INITIAL KHAH ≈ <initial> 062E  Arabic letter khah ≈ FEA7  Arabic letter khah initial form
ذـ	MATHEMATICAL INITIAL DAD ≈ <initial> 0636  Arabic letter dad ≈ FEBF  Arabic letter dad initial form
غـ	MATHEMATICAL INITIAL GHAIN ≈ <initial> 063A  Arabic letter ghain ≈ FECF  Arabic letter ghain initial form

Table 13: Mathematical initial alphabetic symbols

ع	MATHEMATICAL YEH RAJIAT ≈ 06D2 ع Arabic letter yeh barree
ك	MATHEMATICAL KAF ZIDANY ≈ 06AA ك Arabic letter swash kaf
لا	MATHEMATICAL LAMALEF ≈ FEFB لا Arabic ligature lam with alef
ى	MATHEMATICAL ALEF MAKSURA ≈ 0649 ى Arabic letter alef maksura
ء	MATHEMATICAL HAMZA ≈ 0621 ء Arabic letter hamza
ب	MATHEMATICAL DOTLESS BEH ≈ 066E ب Arabic letter dotless beh
د	MATHEMATICAL INITIAL DOTLESS BEH ≈ FBE8 د Arabic letter Uighur Kazakh Kirghiz alef maksura initial form
ف	MATHEMATICAL DOTLESS FEH ≈ 066F ف Arabic letter dotless feh
و	MATHEMATICAL INITIAL DOTLESS FEH
پ	MATHEMATICAL PEH ≈ 067E پ Arabic letter peh
ح	MATHEMATICAL TCHEH ≈ 0686 ح Arabic letter tcheh
ڤ	MATHEMATICAL VEH ≈ 06A4 ڤ Arabic letter veh
ع	MATHEMATICAL GHEH ≈ 06A0 ع Arabic letter ain with tree dots above

Table 14: Mathematical others alphabetic symbols

References

- [1] Unicode Technical Report #25, *Unicode Support for Mathematics*,
<http://www.unicode.org/reports/tr25/>.
- [2] W3C Math Interest Group Note, *Arabic Mathematical Notation*,
<http://www.w3.org/TR/arabic-math/>.
- [3] Azzeddine Lazrek, *Arabic mathematical symbols for Unicode*,
<http://www.ucam.ac.ma/fssm/rydarab/english/unicode.htm>.
- [4] Unicode, *Bidi Mirroring Glyph Property*,
<http://www.unicode.org/Public/UNIDATA/BidiMirroring.txt>.
- [5] Mohamed Jamal Eddine Benatia, Azzeddine Lazrek and Khalid Sami,
Arabic mathematical symbols in Unicode, Internationalization and
Unicode Conference (IUC), IUC 27, Berlin, Germany, April 6-8, 2005,
<http://www.ucam.ac.ma/fssm/rydarab/doc/communic/unicodem.pdf>.

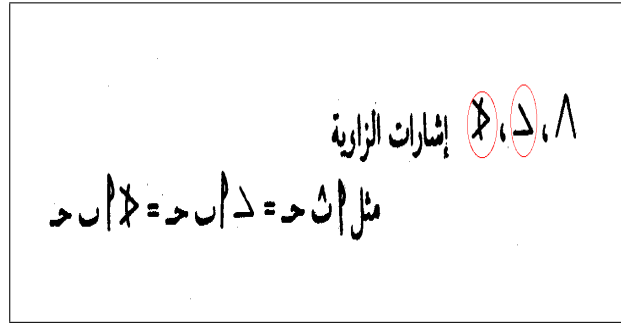


Figure 1: Angle symbol in Amman Convention [1.1]

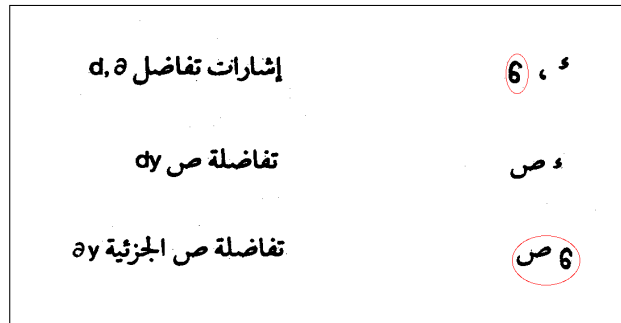


Figure 2: Differential symbol in Amman Convention [1.1]

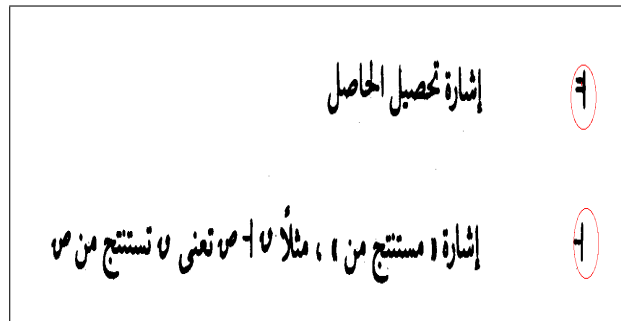


Figure 3: Consequence symbol in Amman Convention [1.1]

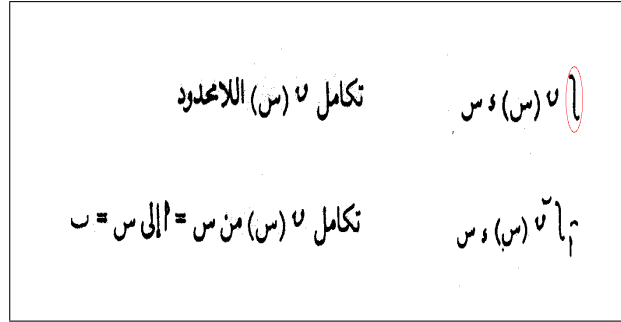


Figure 4: Integral symbol in Amman Convention [1.1]

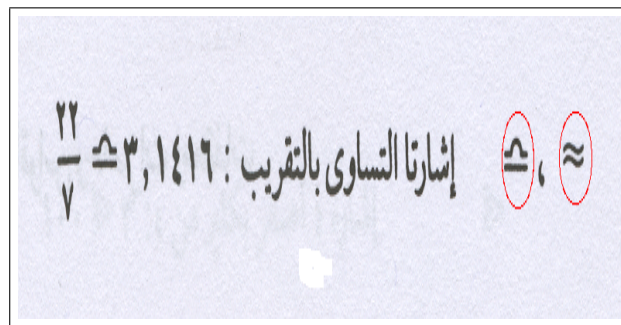


Figure 5: Asymptotically equal to symbol in Amman Convention [1.1]

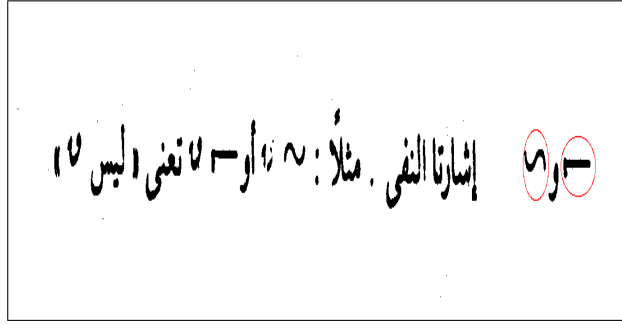


Figure 6: Negation symbol in Amman Convention [1.1]

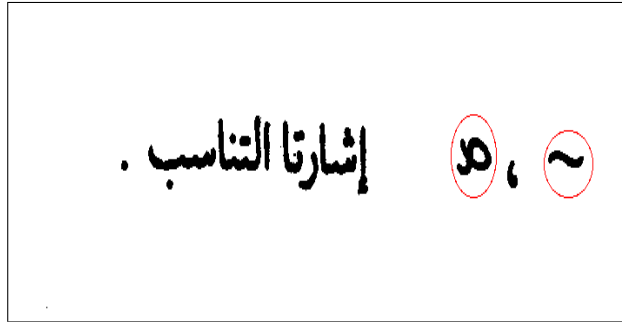


Figure 7: Proportional symbol in Amman Convention [1.1]

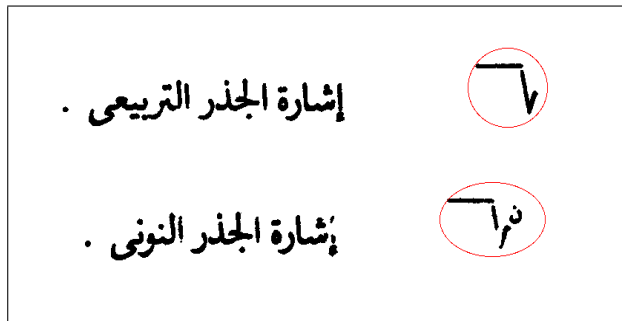


Figure 8: Root symbol in Amman Convention [1.1]

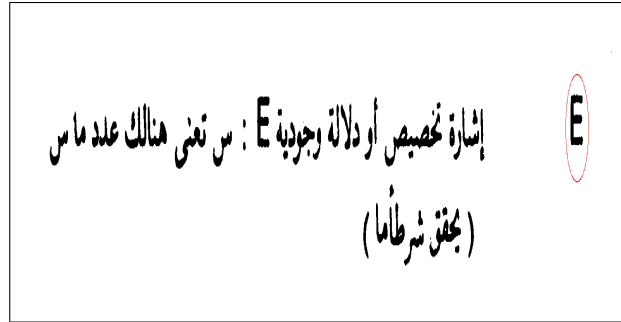


Figure 9: There exists symbol in Amman convention [1.1]

ومن المفيد أن يعرف التلييد المصطلحات الهندسية الآتية التي تستخدم في الحل تسهيلاً للسير في خطواته .

الرمز	المعنى	الرمز	المعنى
∴	بما أن أي حيث أن	∠	زاوية قائمة
∴	إذن (إذاً)	=	يساوي
∠	زاوية	≠	لا يساوي
△	مثلث	□	متوازي الأضلاع
//	يوازي	∩	القوس م
⊥	عمودي على		
<	أكبر من		
>	أصغر من		

Figure 10: Some symbols in Handbook

فكلما تغيرت السرعة والزمن تتغير تبعاً لها المسافة المقطوعة ، ولذا يقال أن :

$$f = d (e, n)$$

ومساحة شبه المنحرف م الذي أطوال قاعدتيه وارتفاعه هي على الترتيب ق^١ ، ق^٢ ، ع نحصل عليها من الصورة :

$$m = e \times \frac{(q^1 + q^2)}{2} \quad \text{أي أن :}$$

$$m = d (q^1, q^2, e)$$

Figure 11: Prime symbol in Handbook [3.5]

س

نصف القطر

Figure 12: Ray symbol in Amman convention [1.1]

كذلك إذا كان $m = s$ فإنه يمكن كتابة هذه العلاقة بصيغة أخرى هكذا

$$l = s = m$$

Figure 13: Logarithm symbol in Handbook [3.3]

عدد توفيقات h عنصرا من مجموعة تشمل n عنصرا هو :

$$\binom{n}{h} = \frac{n(n-1)\dots(n-h+1)}{h!} \quad \text{اذا كان } 1 \leq h \leq n$$

$$1 = \binom{n}{0}$$

$$0 = \binom{n}{h} \quad \text{اذا كان } h > n$$

Figure 14: Symbol in Handbook [3.12]

عدد ترتيبات h عنصرا من مجموعة عدد عناصرها n عنصرا هو :

$$P(n, h) = n(n-1)\dots(n-h+1) \quad \text{اذا كان } h \leq n$$

$$0 = P(n, h) \quad \text{اذا كان } h > n$$

Figure 15: symbol in Handbook [3.12]

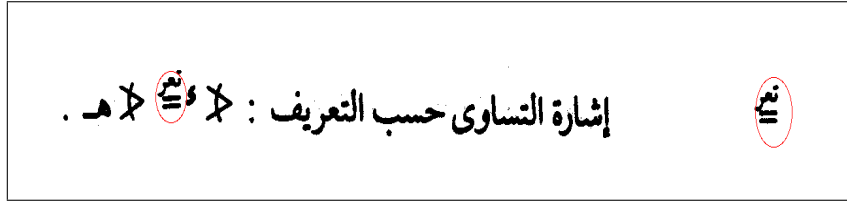


Figure 16: Equal by definition symbol in Amman Convention [1.1]